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A Profile of Advanced Manufacturing in the Southeast Region: Key Industry and Occupational Trends

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Executive Summary

This report provides a detailed examination of Advanced Manufacturing in the Southeast region. This report is part of an eight-part series, each focusing on different areas of the Commonwealth. It examines recent employment and earnings trends; analyzes key occupations in Advanced Manufacturing's subsectors, looking for common labor needs and comparing wages to similar workers in other industries; identifies the most common and critical skills needed by employers; and offers a detailed demographic profile of Advanced Manufacturing to highlight areas of critical concern for the future health of the industry.

With nearly 30,000 workers and over 1,000 businesses, the Southeast region's Advanced Manufacturing sector is the third largest in the state. However, it represents only a modest share of the total regional economy. Unlike most other regions, Advanced Manufacturing in the Southeast is not dominated by any single subsector. The largest subsectors are Fabricated Metals and Equipment, Computers and Electronics and Food Processing. However, its primary regional specialization is in Medical Equipment and Supplies manufacturing, where the region's employment share in this sector is more than three times the nation's. Earnings in the Southeast also tend to lag most other regions in the Commonwealth. The major exception is the region's Medical Equipment and Supplies subsector, where wages exceed both the state and the nation. But while not as high as found elsewhere, workers in the region's Advanced Manufacturing sector still surpass those of most other jobs in the region.

Advanced Manufacturing in the Southeast experienced decades of consistent layoffs and business closures. Since 2001, Advanced Manufacturing lost a net 11,000 jobs—nearly a third its total jobs base**.** But the regional impact of these losses were blunted by the relative small size of the region's Advanced Manufacturing sector. Nearly half of these layoffs were in the Computers and Electronics subsector—but only the Food Processing sector actually added net jobs over the past 11 years. And while job losses have abated following the 2008 recession, Advanced Manufacturing in the region has not kept pace with national trends of net job creation.

The aging of the Advanced Manufacturing workforce poses a major challenge to the region in the years ahead. More than 27% of today's workforce will reach retirement age within the next ten years—a larger share than either the nation or the state. But with proper training and outreach, these retirements may create opportunities for young workers and others having a hard time finding a path to well-paying jobs in the modern economy. We also find considerable overlap in skill requirements across the varied Advanced Manufacturing subsectors in the region, suggesting ample opportunities for targeted training programs that meet the needs of a variety of employers.

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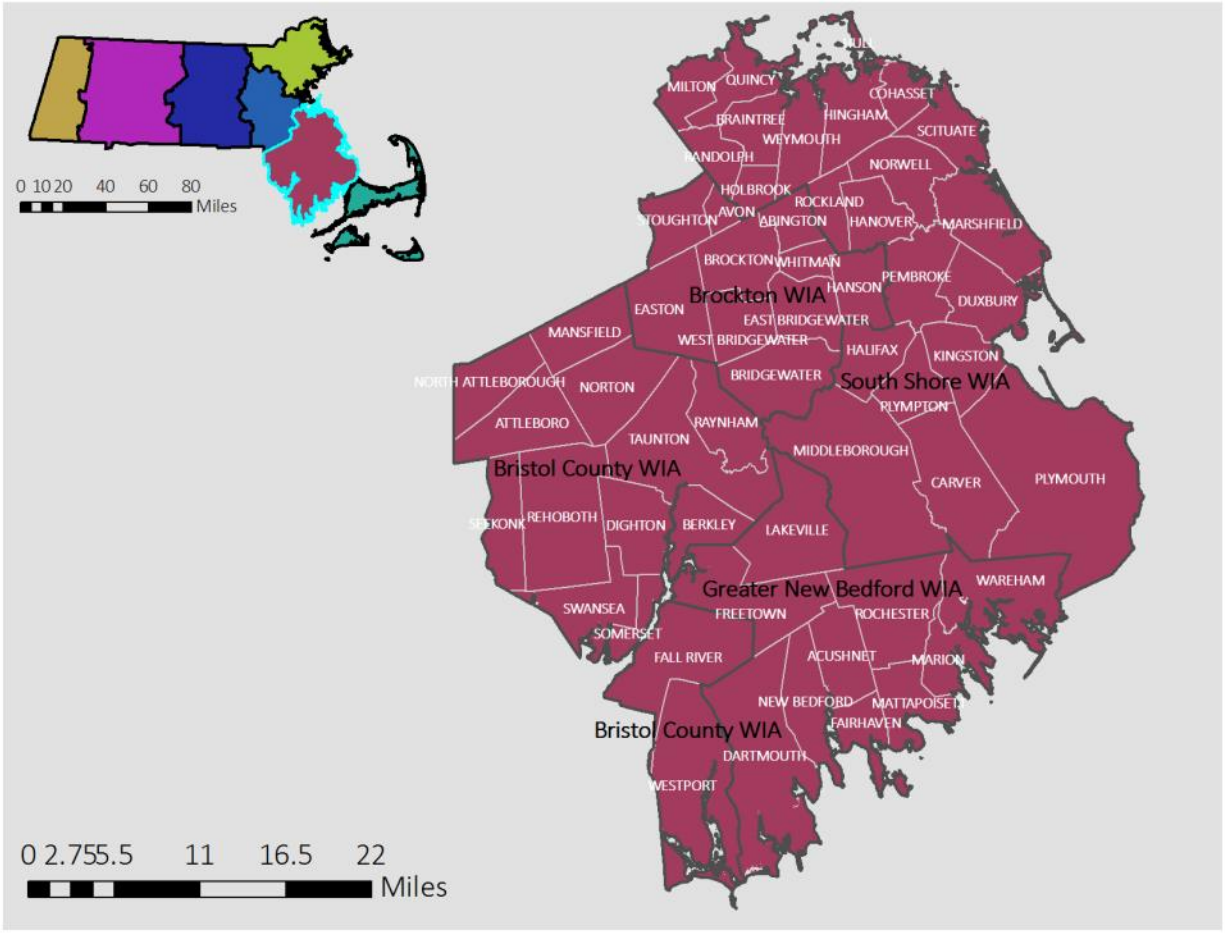
Introduction

Study Purpose and Scope

This report provides a detailed examination of the industrial ecology and occupational composition of Advanced Manufacturing in the Southeast region (Figure 1). Its purpose is to provide up-to-date and actionable information to help guide policy and program decisions directed at securing a strong future for the region's Manufacturing sector. The industry definitions of the Advanced Manufacturing sector are provided in Appendix A. A more in-depth discussion on the rationale behind these definitions is provided in the state-level companion report titled "A Profile of Advanced Manufacturing in the Commonwealth: Key Industry and Occupational Trends."

Figure 1
The Southeast Region



This report is one of seven regional profiles of the Advance Manufacturing sector (Appendix B). This report focuses on industry and occupational trends within the Southeast region, making reference to other regions or the state for the sake of comparison.

This report follows a similar template and format as the state-level study, and is based on an analysis of common public data sources. It opens with a review of recent industrial trends—employment, wages and salaries—as well as a discussion of the impact of the recent recession and recovery.

Next, we move on to a detailed examination of the most prominent and specialized (i.e. "core") occupations in Advanced Manufacturing sector and its component subsectors. We also consider crossover occupations than are prevalent in multiple industries within Advanced Manufacturing, which provide likely targets for training programs that offer the greatest benefit to the most employers. This is followed by an analysis of the specific types of skills that are used and required by these core occupations. Skills transcend both occupations and industries, and thus regrouping occupations in terms of complimentary and similar skills provides another venue for identifying possible targets for training and other development programs.

This report closes with a detailed demographic profile of the people that work in Advanced Manufacturing in the Southeast. We pay particular attention to areas of critical concern for the future health of the industry, such as the aging of the workforce, the gender gap, commuting patterns, educational attainment, and the prevalence of foreign born workers. Our demographic profile uses similar data sources and many common metrics covered by the recent regional labor force profiles of the Federal Reserve Bank of Boston[1]. It differs in that our analysis focuses solely on the Advanced Manufacturing workforce, while the Federal Reserve Bank profiles focus on the entirety of the labor market with only limited coverage of workers in specific industries.

[1] The report and interactive data viewer for the Federal Reserve Bank of Boston labor market profiles can be viewed at http://www.bostonfed.org/economic/neppc/labor-market-trends-in-massachusetts-regions/

Industry Trends in the Southeast Region

Advanced Manufacturing is a crucial component of the Southeast regional economy. With nearly 30,000 employees and over 1,000 businesses in 2012, the Southeast region's Advanced Manufacturing sector is the third largest in the Commonwealth (Table 1). But because of its size and diversity, Advanced Manufacturing represent only a modest share of the total regional economy (5.7%, Figure 2). Although it may be less specialized in Advanced Manufacturing when compared to most other regions in Massachusetts, it is fairly close to the national average. In other words, employment in the Advanced Manufacturing sector in the Southeast is just about what we would expect for a region its size.

The Advanced Manufacturing sector has faced a long and steady decline in the Southeast over the past several decades. However, there are signs that it is beginning to stabilize—although it still lags national trends of job creation. The region's Advanced Manufacturing sector lost 220 establishments and nearly 10,000 jobs since 2001 and 2012—equivalent to just over a quarter of the sector's 2001 employment or three percent of the region's entire 2001 employment base (Figure 3). While clearly a significant loss, nearly all other areas of the state had it much worse in terms of the relative impact of these job losses.

Table 1
Employment, Establishment, and Earnings Summary by Major Industry Sectors, 2012

	Establishments			Employment			Real Wage and Salary Earnings*	
Sector	Number	Change from 2001	Average Size	Number	Change from 2001	Location Quotient	per Worker	Change from 2001
Advanced Manufacturing	1,038	-220	28.1	29,146	-10,914	0.93	$65,566	$5,647
Other Manufacturing	455	-197	27.6	12,539	-12,973	0.82	$53,919	$6,708
Natural Resources and Mining	362	-23	6.1	2,194	-304	0.28	$85,902	$28,957
Construction	3,965	245	6.6	25,971	-3,008	1.15	$63,201	$809
Trade, Transportation and Utilities	7,754	-403	15.1	117,233	-8,896	1.13	$40,715	-$134
Information	489	-24	18.8	9,203	-3,411	0.84	$67,212	$8,912
Financial Activities	2,590	-10	11.5	29,907	-4,261	1.01	$68,292	$545
Professional and Business Services	5,589	478	9.3	51,889	-284	0.73	$63,926	$7,846
Education and Health Services	3,780	529	35.4	133,931	22,325	1.11	$47,859	$3,130
Leisure and Hospitality	3,437	518	16.3	56,028	6,414	1.01	$17,328	-$1,365
Other Services	9,697	5,232	2.8	27,604	7,848	1.54	$23,055	-$4,026
Public Administration	638	84	29.4	18,747	49	0.66	$60,206	$2,365
Total, all industries	39,794	6,209	12.9	514,392	-7,413	1.00	$47,267	$852

*Measured in 2013 dollars

Source: Massachusetts Department of Labor, Quarterly Employment and Wages (ES-202), Author's Calculations

Employment trends in the Southeast region's Advanced Manufacturing sector have been characterized by a gradual, slow decline—periodically interrupted by a sizable negative shock (Figure 4). The worst of these recent shocks occurred in 2001, when the Advanced Manufacturing sector lost 3,500 jobs during a single year. The sector stabilized over the next few years—even adding a small number of new jobs in 2004. However, the sector was again hit by another shock in 2005 and a third in 2008. The pace of jobs losses in the Advanced Manufacturing sector has slowed in the years since the great Recession, averaging around 350 net layoffs per year since 2010. However, the region is clearly underperforming relative to the nation, which has been adding jobs in Advanced Manufacturing since 2010—not losing them (Figure 4, lower portion).

Figure 2
Regional Distribution of Advanced Manufacturing Employment

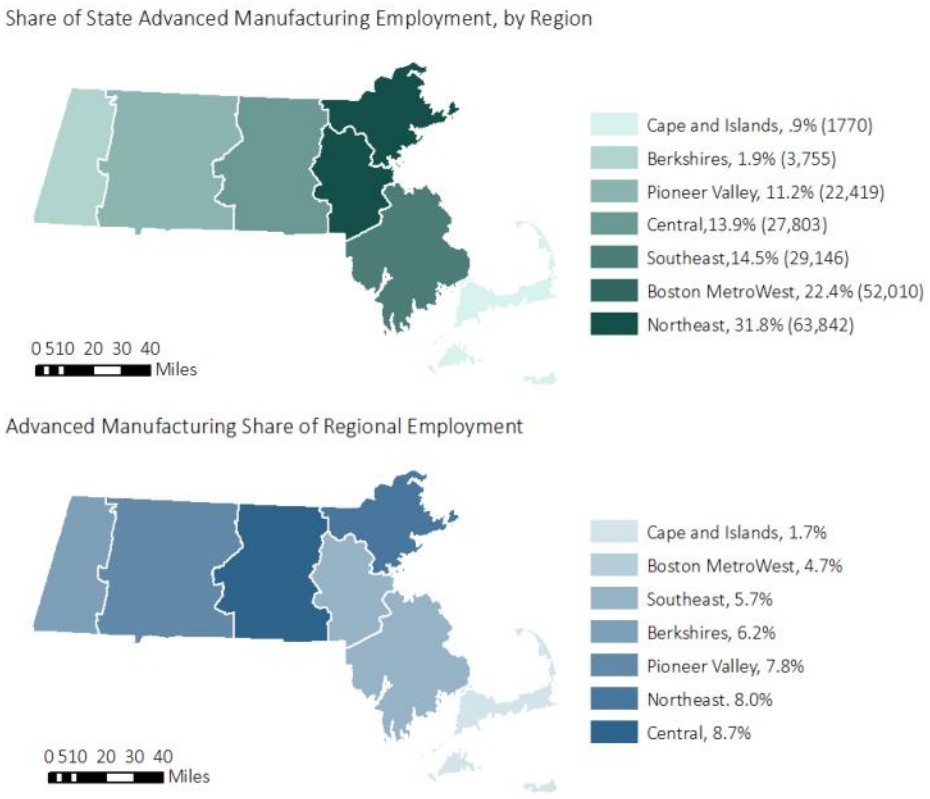
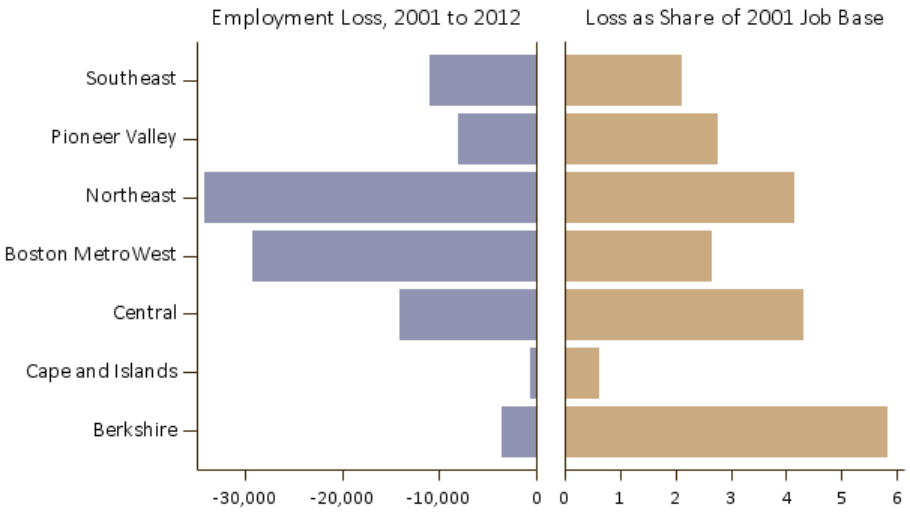


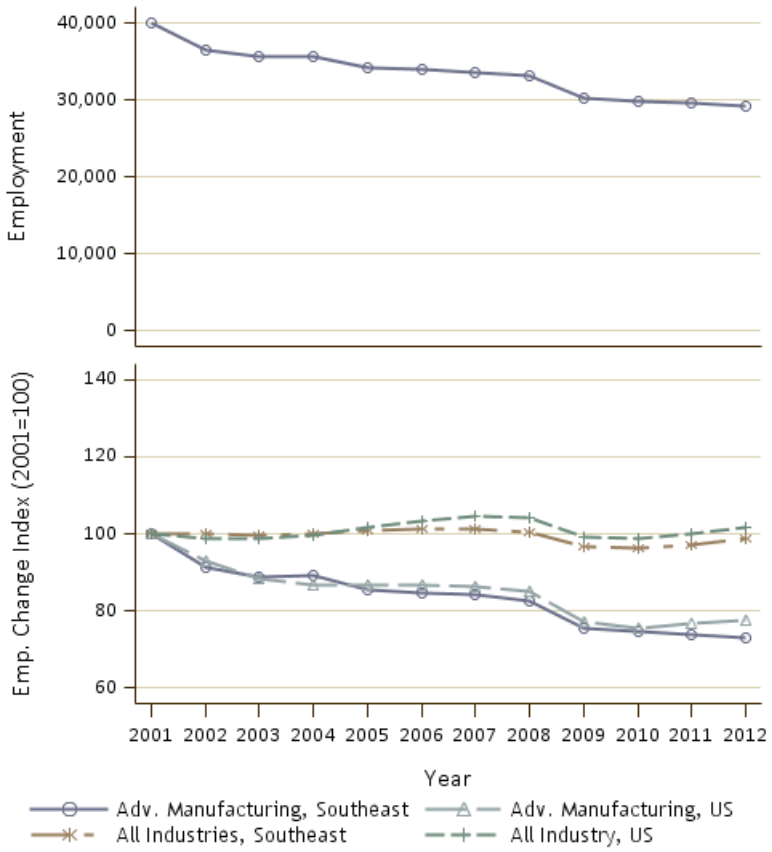
Figure 3
Regional Distribution of Job Losses in Advanced Manufacturing



Source: Massachusetts Department of Labor, Quarterly Employment and Wages (ES-202), Author's calculations

Wages in the Southeast Advanced Manufacturing sector are essentially on par with national standards, but far below the state. On average, workers in the region's Advanced Manufacturing sector earn roughly $2,000 more per year than their national counterparts, but $20,000 dollars less than the Massachusetts average (Figure 5). Only the Cape and Islands and the Pioneer Valley pay less. But while lower than other regions, the average worker in Advanced Manufacturing still earns considerably more than the overall regional average of $48,000 per worker, per year (Figure 5). On the plus side, wage growth in the Southeast region's Advanced Manufacturing sector has generally surpassed the nation for most of the past five years (Figure 6).

Figure 4
Annual employment change in Advanced Manufacturing, 2001 to 2012

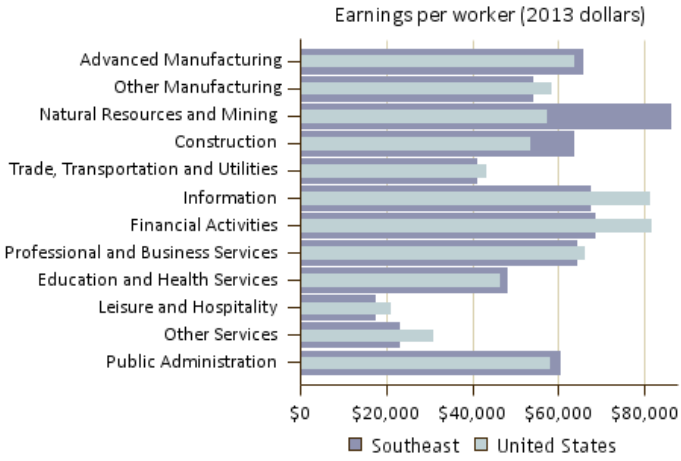


Source: Massachusetts Department of Labor, Quarterly Employment and Wages (ES-202), Author's calculations

Figure 7 helps put recent employment and wage trends into perspective. The vertical axis measures the average earnings per worker for each major industry sector, relative to the regional (all industry) average. The horizontal axis shows the rate of employment growth between 2001 and 2012. The size of each bubble is scaled according to its 2012 employment.

Advanced manufacturing clearly suffered major job losses over the past 12 years, with a rate of job loss that is only exceeded by the remainder of the region's manufacturing sector. The Ad-

Figure 5
Average Earnings per Worker by Major Industry Sector (2012), Southeast region compared to the Nation



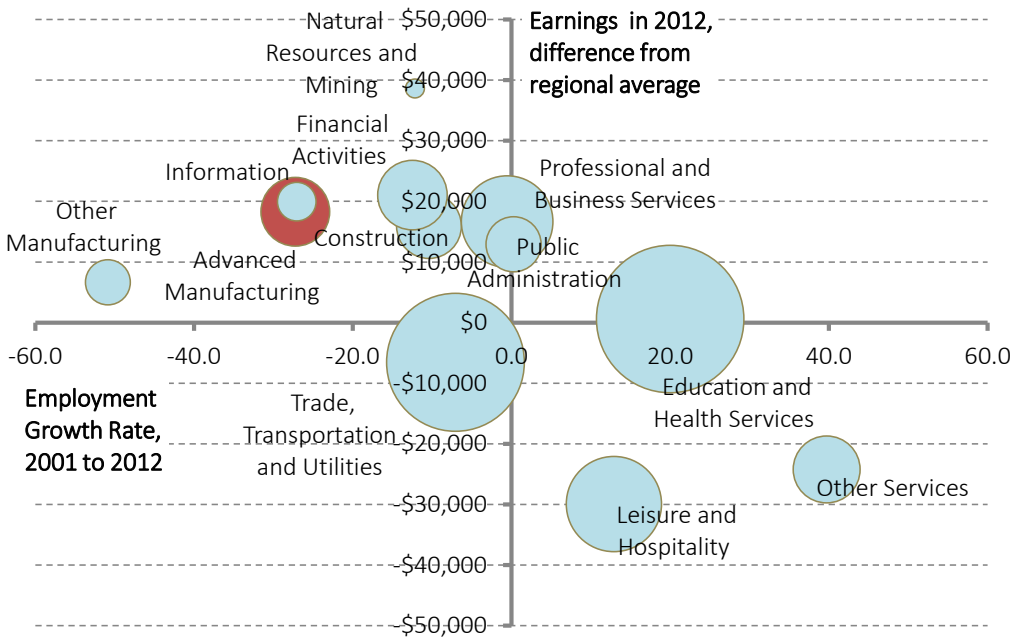
Source: Massachusetts Department of Labor, Quarterly Employment and Wages (ES-202), Author's calculations

vanced Manufacturing sector is relatively smaller than what we typical found for other regions, yet still represents a modest share of the total regional employment base. It also pays above the region average wage. In this respect its wage rates are similar to a number of the other regionally declining sectors—information, construction, and financial activities, but notably higher than the sectors which have added jobs since 2001.

Figure 6
Trends in Real Earnings per Worker in Advanced Manufacturing, Southeast Region vs. the U.S., 2001 to 2012

Source: Massachusetts Department of Labor, Quarterly Employment and Wages (ES-202), Author's calculations

Figure 7
Major Industry Sectors, by Average Earnings, Size, and Growth



Advanced Manufacturing Subsectors in the Southeast Region

Establishments, Employment and Regional Specializations

With over 400 business establishments and nearly 8,000 employees, Fabricated Metals and Machinery is the largest of the seven Advanced Manufacturing subsectors in the Southeast (Table 2). It is closely followed by Computers and Electronics with 7,112 employees in 2012, although with a far fewer 148 establishments. Both have suffered major job losses since 2001, but in Computers and Electronics the decline has been far more dramatic. Computers and Electronics lost over 5,300 jobs, or 43%, of its employment base since 2001. Fabricated Metals lost just under 2,500 jobs, or just under a quarter of its 2001 employment. Although it is smaller and suffered far greater declines, Computers and Electronics is more of a regional specialization in the Southeast than is Fabricated Metals—namely because of the former's smaller share of U.S. total employment (Figure 8).

The most regionally specialized sector is Medical Equipment and Supplies. It is the third smallest subsector in the region, but its employment share is more than three times the U.S. share. There are more Medical Equipment workers in the Southeast than in any other single region in the Commonwealth. But with only 62 establishments, employment in this sector is heavily concentrated in a relatively small number of large employers. It has also suffered significant job losses over the past twelve years, and is far less concentrated in the region as it once was.

Food Processing and Production was the only subsector to add net jobs to the Southeast regional economy since 2001, although still underrepresented relative to the U.S. But while employment has grown, the num-

Table 2
Employment, Establishment, and Earnings Summary by Advanced Manufacturing Sub-Sectors, 2012

	Establishments			Employment			Real Wage and Salary Earnings	
Sub-sector	Number	Change from 2001	Average Size	Number	Change from 2001	Location Quotient	per worker	Change from 2001
Chemicals and Plastics	88	-17	25.2	2,219	-677	0.437	$64,814	$966
Computers and Electronics Products	148	-32	48.1	7,112	-5,369	1.244	$77,209	$12,647
Fabricated Metals & Machinery	404	-78	19.6	7,904	-2,455	0.807	$59,150	$2,932
Food Processing and Production	155	-33	32.6	5,050	469	0.790	$49,901	$14,546
Medical Equipment and Supplies	62	-9	58.0	3,598	-966	2.995	$93,154	$7,797
Paper and printing	181	-51	18.0	3,263	-1,916	0.992	$50,068	-$3,185
Advanced Manufacturing (total)	1,038	-220	28.1	29,146	-10,914	0.926	$65,566	$5,647

*Measured in 2013 Dollars

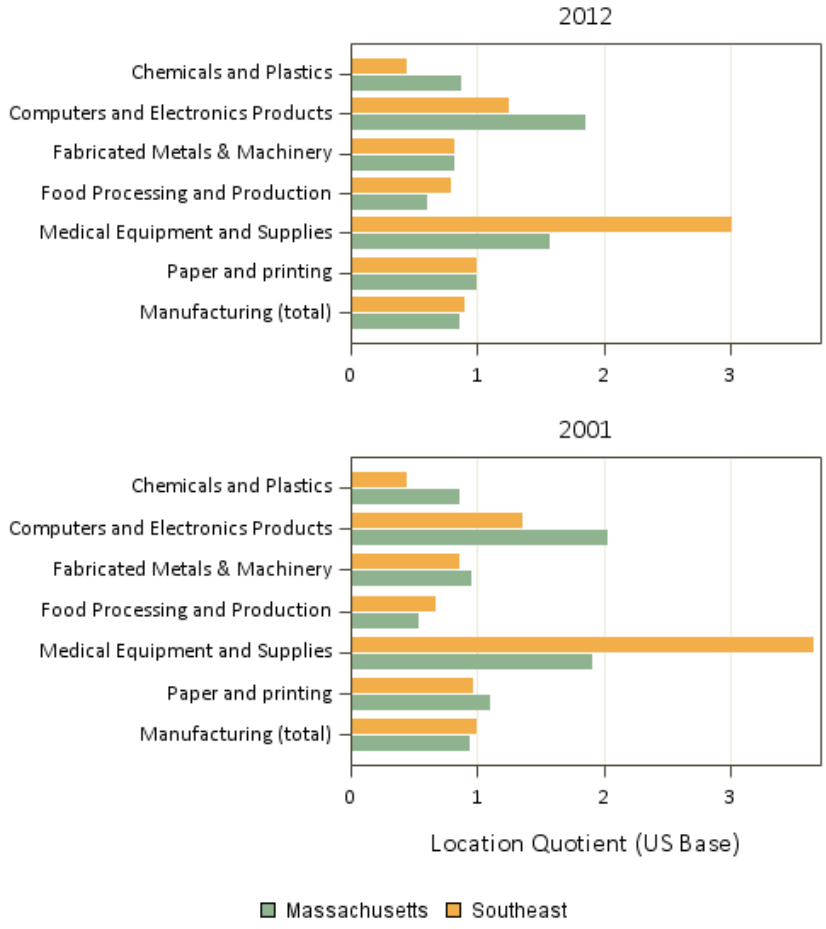
Source: Massachusetts Department of Labor, Quarterly Employment and Wages (ES-202), Author's Calculations

ber of business establishments in the subsector has shrunk. Those that have remained in business have been adding a larger number of workers to their payrolls.

Employment Trends

We previously characterized employment trends in Advanced Manufacturing by steady declines punctuated by episodic shocks. These episodic shocks are partly the consequence of a region lacking a single, dominant, subsector. Instead the Southeast is comprised of several subsectors of near equal size. Although sometimes these shocks reflect market-wide events that hit all subsectors, some are the result of idiosyncratic events specific to a particular subsector.

Figure 8
Relative Concentration of Employment by Advanced Manufacturing Subsector, Southeast vs. the Commonwealth

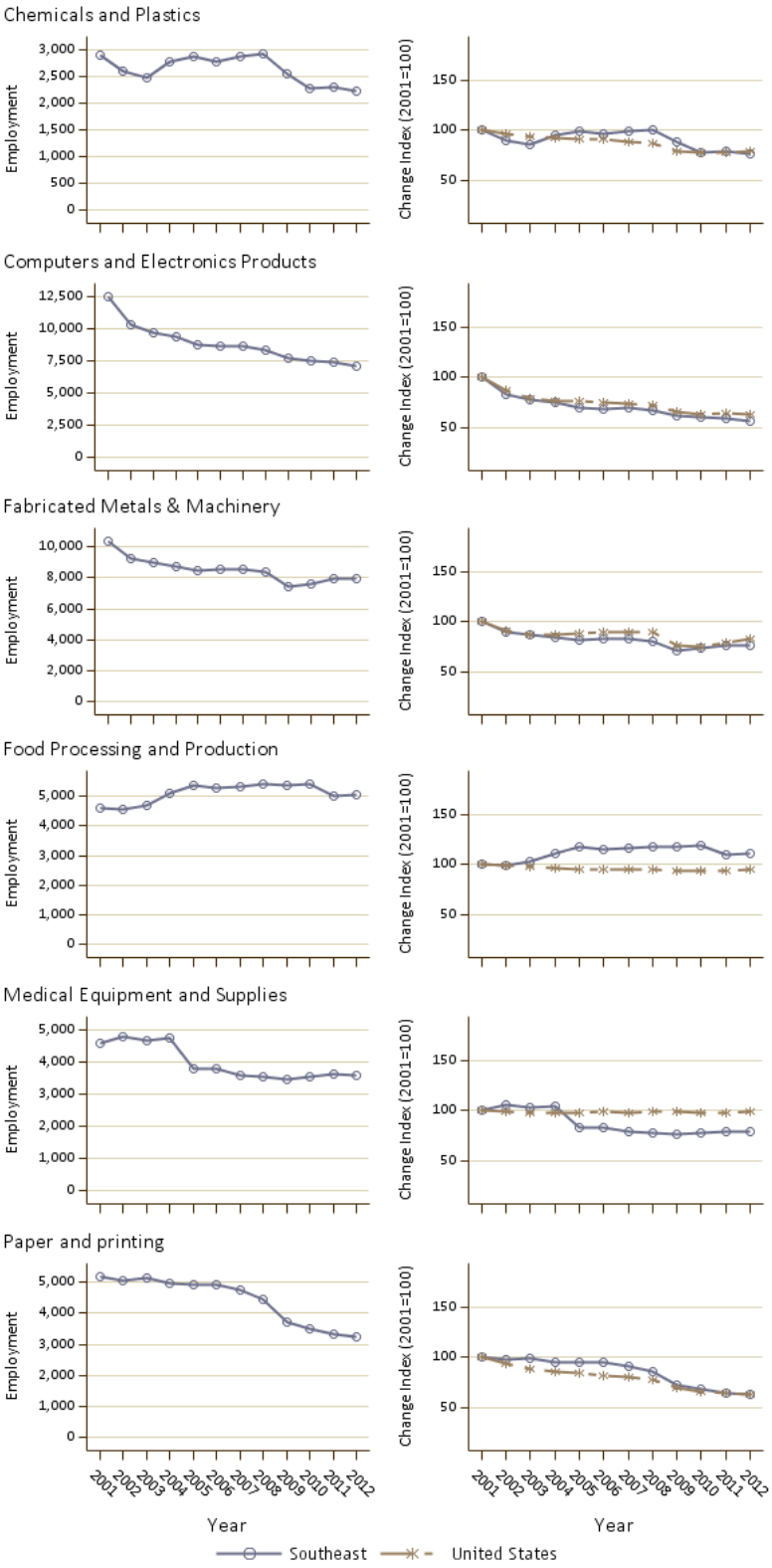


Source: Massachusetts Department of Labor, Quarterly Employment and Wages (ES-202), Author's calculations

Computers and Electronics, Fabricated Metals, and Chemicals and plastics all experienced dramatic employment losses coinciding with the recession of 2001-2002 (Figure 9). Chemicals and Plastics quickly rebounded by mid-decade, but suffered an even more dramatic decline coinciding with the Great Recession. Fabricated Metals also suffered a second shock in 2008, but has been adding jobs since 2010. Following its initial shock in 2001, Computers and Electronics continued to shed jobs in a steady fashion for most the remainder of the study period.

The three remaining subsectors were less directly impacted by the 2001 recession. Job losses were small, but steady, in the Paper and Printing subsector for most of the 2000s. Economic conditions turned south in 2007, and Paper and Printing suffered major losses in 2008. It has continued to lose jobs in the years since, albeit at a slower rate of decline that is commensurate to national trends for the subsector. Medical

Figure 9
Employment Change by Advanced Manufacturing Sub-Sector



Source: Massachusetts Department of Labor, Quarterly Employment and Wages (ES-202), Author's calculations

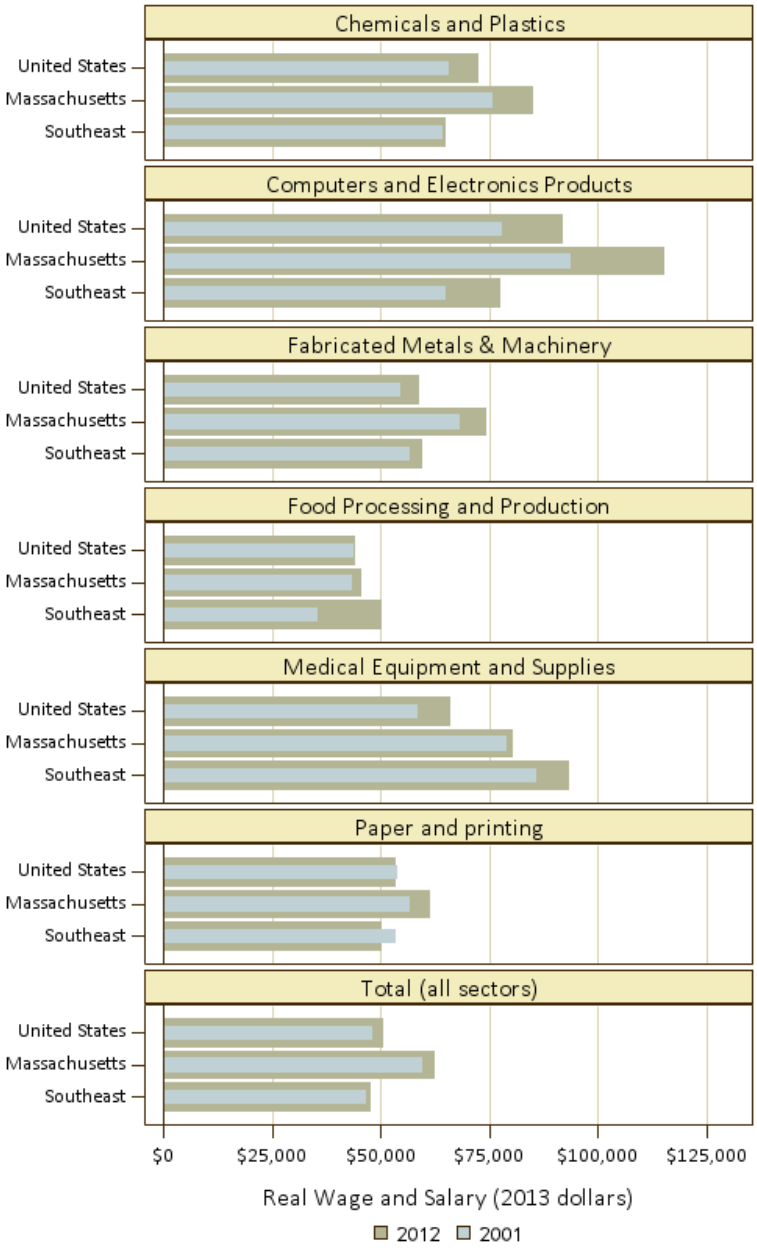
Equipment and Supplies had consistent year-to-year employment levels up to 2004, when it suffered a large single year loss. It is again stabilized, albeit at a lower employment level. Employment in Food Processing grew through most of the early decade, exceeding national trends. However, the pace of growth slowed, and has been fairly flat in the years since 2005.

Earnings and Wage Trends

As found for the Advanced Manufacturing sector as a whole, earnings for the individual subsectors also tend to lag other regions in the state. The major exception is the Southeast's Medical Equipment and Supplies subsector, which exceeds average earnings per worker in both the state and the nation (Figure 10). At an average of $93,000 per worker, per year, Medical Equipment and Supplies is also the highest paying of all Advanced Manufacturing subsectors in the region. Wages in the Food Processing sector also surpassed the Commonwealth, by a modest $4,000 per worker, per year. Food Processing has also experienced fairly rapid wage growth (41%) since 2001. Real earnings also grew by a significant 20% in the

Computers and Electronics products sector, although still lagging wage growth in the Commonwealth and nation. Real earnings in the Paper and Printing subsector declined slightly from 2001. Workers in Paper and Printing now make roughly $3,000 less than they did in 2001.

Figure 10
Annual Earnings per Worker, 2001 to 2012



Source: Massachusetts Department of Labor, Quarterly Employment and Wages (ES-202), Author's calculations

Occupational Profile of the Advanced Manufacturing Subsectors

This section profiles the knowledge, skills and abilities of the Advanced Manufacturing labor pool in the Southeast region. It generally follows a similar structure and format as the companion state-level occupational profile—focusing on the specific occupations identified at the "core" of the Commonwealth's Advanced Manufacturing sector. But there are some important differences. Several of the key data sources used to analyze occupations by industry are only available at the state level. For individual regions, occupational data is limited to total (cross-industry) employment and wages. In other words, the figures discussed in this section include not only workers in Advanced Manufacturing, but workers doing similar jobs in other industries, as well. And while these are considered core occupations in Advanced Manufacturing, the number of employees actually working in Advanced Manufacturing may be far less. Yet, we feel that this analysis does provide an accurate portrayal of the *potential* Advanced Manufacturing workforce, otherwise referred to as the labor pool, because it covers occupations with generally similar skills and aptitudes as those found among workings in the industry.

We begin with a brief profile of the entire regional labor force, classified by major occupational groups that are most closely related to Advanced Manufacturing. We follow with a close examination of the specific core occupations of the Advanced Manufacturing sector as a whole. The section closes with a brief discussion of employment and wage trends for occupations considered core to the six individual Advanced Manufacturing subsectors.

Regional Occupational Structure

Table 3 presents total employment in the Southeast region across major occupational categories—focusing on those previously identified as particularly prevalent in the Commonwealth's Advanced Manufacturing sector. The largest share of the Southeast region's labor force is in office and administrative support occupations (17%) —a share consistent with the state and most other regions. The Southeast contains about 31,700 workers in production oriented jobs, or about 6.4% of the total regional labor force—a share similar to the nation but underrepresented relative to the state average. Various subsectors also draw upon engineers, scientists, and workers in computers in math; all categories underrepresented in the region. With a location quotient of (1.19), the region has a mild concentration in healthcare practitioners and technical occupations which may reflect the high concentration of workers in the region's Medical Equipment and Supplies subsector.

Table 3

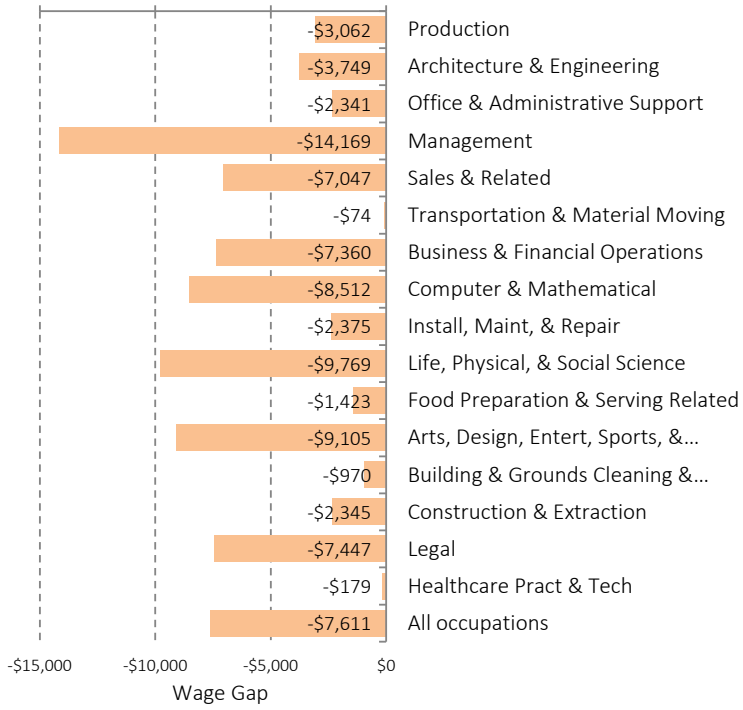
Major Occupational Groups within Advanced Manufacturing and total regional employment, 2012

SOC	Occupational Category	Region wide Workers	Industry Share	Location Quotient	Annual wage
51-0000	Production Occupations	31,690	6.4%	0.96	$35,056
17-0000	Architecture and Engineering Occupations	6,160	1.2%	0.68	$80,616
43-0000	Office and Administrative Support Occupations	84,700	17.0%	1.04	$37,625
11-0000	Management Occupations	28,310	5.7%	1.16	$109,333
41-0000	Sales and Related Occupations	61,500	12.3%	1.16	$38,251
53-0000	Transportation and Material Moving Occupations	29,870	6.0%	0.89	$35,832
13-0000	Business and Financial Operations Occupations	21,220	4.3%	0.86	$70,743
15-0000	Computer and Mathematical Occupations	9,410	1.9%	0.69	$83,146
49-0000	Installation, Maintenance, and Repair Occupations	18,400	3.7%	0.95	$48,620
19-0000	Life, Physical, and Social Science Occupations	2,440	0.5%	0.58	$67,779
35-0000	Food Preparation and Serving Related Occupations	43,150	8.7%	0.98	$24,292
27-0000	Arts, Design, Entertainment, Sports, and Media Occupations	5,230	1.0%	0.78	$49,465
37-0000	Building and Grounds Cleaning and Maintenance Occupations	11,810	2.4%	0.73	$31,310
47-0000	Construction and Extraction Occupations	18,520	3.7%	0.97	$54,377
23-0000	Legal Occupations	1,770	0.4%	0.45	$101,946
29-0000	Healthcare Practitioners and Technical Occupations	34,940	7.0%	1.19	$81,408
00-0000	Total all occupations	498,160	100.0%	1.00	$48,545

Source: MA Office Labor and Workforce Development (EOLWD) OES, author's calculations. Includes Major SOC categories with occupations in Advanced Manufacturing indicated by the state report. Wages in 2013 dollars.

Figure 11

Difference in major occupational category earnings, Region v. MA



Source: MA EOLWD, OES; US BLS, OES; author's calculations. In 2013 dollars.

Workers across most all major occupational categories in Advanced Manufacturing earn notably lower wages than the corresponding statewide average (Figure 11). Common Advanced Manufacturing occupations such as architecture and engineering, computer and mathematical, and science oriented occupations earn substantially less. However, there is little earnings gap for regional healthcare practitioners and technicians relative to their counterparts elsewhere in the state.

Advanced Manufacturing Core/Crossover Occupations

Table 4 reports the core/crossover occupations of the Advanced Manufacturing sector that were identified in our state-level analysis. Occupations that are "core" in a particular subsector are designated by an "X". Table 4 also includes regional employment totals for each occupation, as well as subsector industry employment levels (as reported in the previous section) to provide a sense of each subsector's contribution to the region's Advanced Manufacturing base. It is important to note that the industry employment numbers

Table 4
Summary Employment and Core Advanced Manufacturing Crossover Occupations, 2012

SOC	Occupational Title	Region wide workers	Chem. and Plastics	Comps. and Elect.	Fab. Metals and Mach.	Food Process. & Prod.	Medical Equip. and Supplies	Paper and Printing
11-9041	Architectural & Engineering Managers	820	x	x	x		x	
51-4011	Computer-Controlled Machine Tool Operators, Metal & Plastic	430	x	x	x		x	
51-4031	Cutting, Punching, & Press Machine Setters, Operators, & Tenders, Metal & Plastic	350	x	x	x		x	x
17-3023	Electrical & Electronics Engineering Technicians	550		x	x		x	
51-2023	Electromechanical Equipment Assemblers	200		x	x		x	
51-4021	Extruding & Drawing Machine Setters, Operators, & Tenders, Metal & Plastic	520	x	x	x			
51-1011	First-Line Supervisors of Production & Operating Workers	2,260	x	x	x	x	x	x
51-9198	Helpers--Production Workers	1,420	x	x	x	x	x	x
17-3026	Industrial Engineering Technicians	270	x	x	x			x
17-2112	Industrial Engineers	550	x	x	x		x	x
49-9041	Industrial Machinery Mechanics	560	x	x	x	x	x	x
11-3051	Industrial Production Managers	600	x	x	x	x	x	x
51-9061	Inspectors, Testers, Sorters, Samplers, & Weighers	1,500	x	x	x	x	x	x
51-4041	Machinists	1,730	x	x	x		x	
17-2141	Mechanical Engineers	1,030	x	x	x		x	
51-4072	Molding, Coremaking, & Casting Machine Setters, Operators, & Tenders, Metal &	260	x	x	x			
51-4081	Multiple Machine Tool Setters, Operators, & Tenders, Metal & Plastic	320		x	x		x	
51-9111	Packaging & Filling Machine Operators & Tenders	2,260	x			x		x
51-2092	Team Assemblers	2,760		x	x	x	x	x
51-4111	Tool & Die Makers	230	x		x		x	x
Subsector Advanced Manufacturing industry employment (ES-202)	Share		7.6%	24.4%	27.1%	17.3%	12.3%	11.2%
	Number		2,219	7,112	7,904	5,050	3,598	3,263

Source: Massachusetts EOLWD, OES and ES-202 data series; author's calculations

include only those workers specific to the subsector, regardless of occupation. Whereas the occupational employment totals report all workers in the region, and not just those in Advanced Manufacturing.

The industrial composition of Advanced Manufacturing in the Southeast is somewhat distinct among the seven regions of the Commonwealth. While Metal Fabrication and Computers and Electronics are the largest subsectors, there is also a relatively large presence in Food Processing and Production as well as Medical Equipment and Supplies. In terms of the core/crossover occupations, the region's high specialization in Medical Equipment and Supplies nicely compliments Computers and Electronics and Fabricated Metals, which have many core occupations in common.

There are likely many opportunities to leverage scale economies in training programs and mentoring or apprenticeship programs to bridge labor force and industry demands in the Southeast. The largest and most highly specialized subsectors in the region, namely Medical Equipment, Computers and Electronics, and Fabricated Metals, have many core occupations in common. Team assemblers and first-line supervisors are the largest of the core/crossover occupations—both are fairly ubiquitous and can found in large numbers in nearly all subsectors (Table 4). The Southeast labor pools also boast a large number of packaging and filling machine operators; machinists; and inspectors, testers, sorters, samplers, and weighers. Package and filling machine operators tend to have a particularly large presence in Food Processing, while machinists are core workers common to multiple subsectors.

Chemicals and Plastics

While it shares a number of 'core/crossover' occupations with other subsectors, Chemicals and Plastics differs by its relatively high share of workers in scientific fields: chemists, biologists, and chemical/biological engineers and technicians that have rather specialized knowledge. Table 5 displays total occupational employment and wage trends in the Southeast region for the occupations identified as core to the Chemicals and Plastics subsector that are reported for the region.

Except for packaging and machine filling operators, the four largest occupations in the core labor pool in Chemicals and Plastics are also considered core occupations in all of the other subsectors. This suggests a that there is a deep labor pool from which firms may access workers with needed skills. The occupations more specialized to just Chemicals and Plastics include occupations that tend to be science based, such as chemical technicians and biomedical engineers, as well as various specialized machine setters and operators. Several types of machine-oriented occupations found in Chemicals and Plastics are also common to

Table 5
Summary Employment and Earnings Statistics, Key Occupations in Chemicals and Plastics, 2012

		Employment			Real Wage	
SOC	Occupational Title	Number	Change from 01	Location Quotient	Per worker	Change from 01
51-1011	First-Line Supervisors of Production and Operating Workers	2,260	-950	1.04	$61,555	$3,269
51-9111	Packaging and Filling Machine Operators and Tenders	2,260	1,970	1.61	$23,073	-$7,270
51-9061	Inspectors, Testers, Sorters, Samplers, and Weighers	1,500	-360	0.86	$39,188	$2,939
51-9198	Helpers--Production Workers	1,420	-310	0.88	$26,845	-$1,796
11-3051	Industrial Production Managers	600	-80	0.98	$96,950	$5,923
49-9041	Industrial Machinery Mechanics	560	30	0.49	$53,469	$2,072
17-2112	Industrial Engineers	550	180	0.65	$86,526	$6,488
51-4021	Extruding and Drawing Machine Setters, Operators, and Tenders, Metal and Plastic	520	-40	1.83	$38,729	$2,304
17-3026	Industrial Engineering Technicians	270	220	1.05	$49,630	-$1,739
51-4072	Molding, Coremaking, and Casting Machine Setters, Operators, and Tenders, Metal and Plastic	260	-70	0.55	$31,850	$230
51-4111	Tool and Die Makers	230	-250	0.79	$51,350	-$1,261
51-9023	Mixing and Blending Machine Setters, Operators, and Tenders	200	120	0.45	$39,889	-$36
17-2031	Biomedical Engineers	170	-	2.36	$100,951	-
19-4031	Chemical Technicians	120	50	0.51	$43,585	-$2,543
51-9041	Extruding, Forming, Pressing, and Compacting Machine Setters, Operators, and Tenders	60	-210	0.23	$32,579	-$4,232

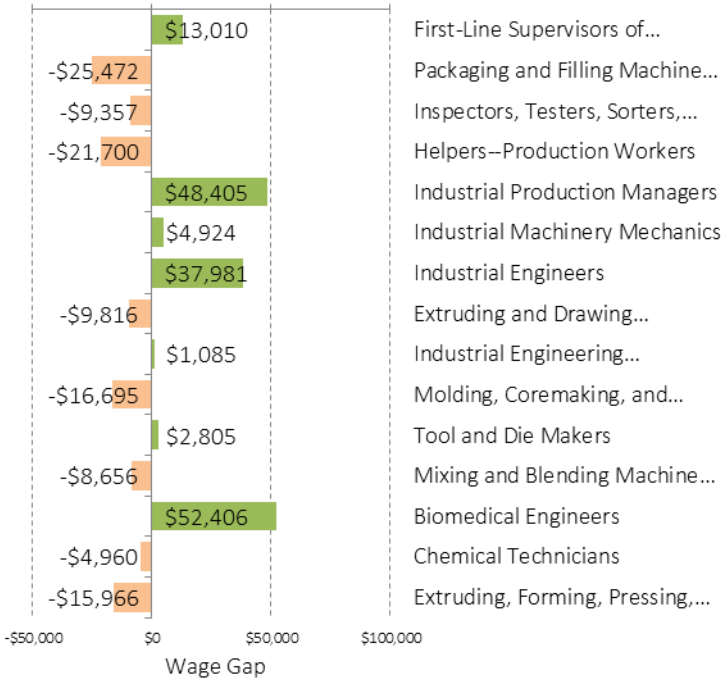
Source: Massachusetts EOLWD, OES; author's calculations. Wages in 2013 dollars.

several other subsectors that may draw upon these workers more intensely. We find relatively few core Chemicals and Plastics occupations that are highly specialized in the regional labor pool, with the notable exception of biomedical engineers that are more than twice as prevalent in the regional labor pool relative to the nation. However, it is difficult to determine to what extent these workers are hired by businesses in the Chemicals and Plastics subsector—especially given the significance of Medical Equipment and Supplies that shares several occupations in common with Chemicals and Plastics. Employment trends appearing within specific occupations are varied and difficult to discern — a possible consequence of suppression in the source data underlying our estimates of occupational employment in the Southeast. Therefore, we caution against a strict interpretation of these trends as an accurate measure of job gains or losses.

Following regional patterns in the subsector, wages for the core labor pool vary in relation to the regional average. Managerial and engineering occupations typically earn significantly higher wages than the regional average, while several of the machine- and technically-oriented jobs earning notably less (Figure 12). Bio-

medical engineers earn the highest wages (about $101,000), while the abundant packaging and filling machine operators earn less than a quarter of biomedical engineers and production managers. These differences may be reflective of various specializations, education, and skill requirements of these workers. Wage trends of core labor pool workers have also varied for the most part since 2001, with production mangers, engineers, and industrial machinery mechanics seeing their real wages increase, while various machine operators experienced declines.

Figure 12
Difference in occupational earnings for workers in Chemicals and Plastics v. regional average wage across all workers



Source: MA EOLWD, OES; author's calculations. Wages in 2013 dollars.

Computers and Electronics

Our statewide analysis showed that the Computers and Electronics subsector has a relatively large number of computer, math and engineering occupations relative to other sectors. These occupations tend to have high skill and knowledge requirements and more formal requirements for post-secondary educational training. We also found that many of the core occupations listed were highly specialized to this subsector, including occupations such as electrical equipment production, electrical engineering, and semiconductors processing.

Turning to our analysis of the Computers and Electronics labor pool in the Southeast region, we find a prevalence of core/crossover occupations that are common across many Advanced Manufacturing subsectors; such as team assemblers, supervisors, and machinists (Table 6). Among the types of occupations that are more specific to Computers and Electronics, we find a rather deep regional pool of electrical and electronic equipment assemblers and mechanical engineers. Software developers are significantly underrepresented. In general, employment in the core labor pool has declined since 2001, though missing data due to suppression may influence some of these values.

For the most part, wages for the core labor pool are significantly higher than the regional average, with the exception of a few more hands-on jobs, such as team assemblers and electrical and electronic equipment

Table 6

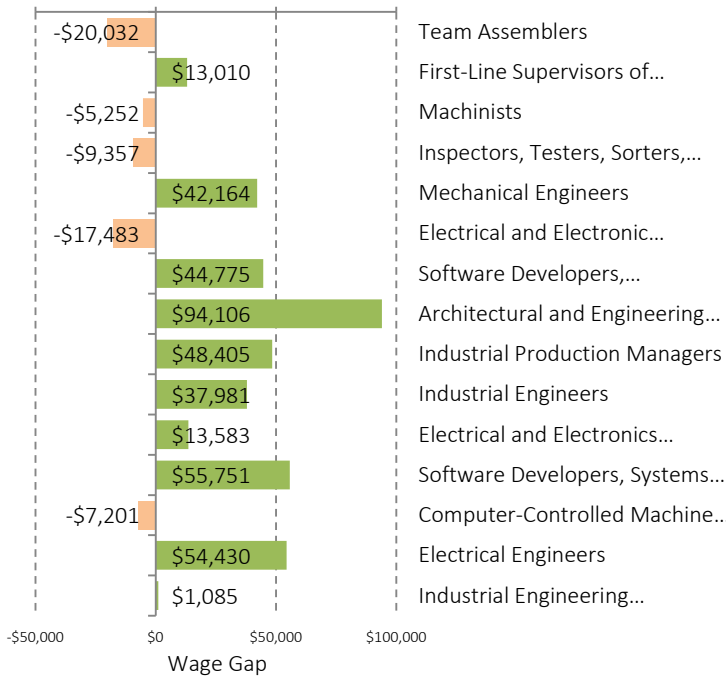
Summary Employment and Earnings Statistics, Key Occupations in Computers and Electronic Products, 2012

		Employment			Real Wage	
SOC	Occupational Title	Number	Change from 01	Location Quotient	Per worker	Change from 01
51-2092	Team Assemblers	2,760	-1,990	0.72	$28,513	-$3,008
51-1011	First-Line Supervisors of Production and Operating Workers	2,260	-950	1.04	$61,555	$3,269
51-4041	Machinists	1,730	110	1.17	$43,293	-$4,701
51-9061	Inspectors, Testers, Sorters, Samplers, and Weighers	1,500	-360	0.86	$39,188	$2,939
17-2141	Mechanical Engineers	1,030	560	1.07	$90,709	$8,643
51-2022	Electrical and Electronic Equipment Assemblers	940	-1,070	1.24	$31,062	-$2,234
15-1132	Software Developers, Applications	930	-	0.41	$93,320	-
11-9041	Architectural and Engineering Managers	820	270	1.14	$142,651	$19,134
11-3051	Industrial Production Managers	600	-80	0.98	$96,950	$5,923
17-2112	Industrial Engineers	550	180	0.65	$86,526	$6,488
17-3023	Electrical and Electronics Engineering Technicians	550	-120	1.00	$62,128	$4,672
15-1133	Software Developers, Systems Software	450	-	0.30	$104,296	-
51-4011	Computer-Controlled Machine Tool Operators, Metal and Plastic	430	240	0.81	$41,344	$801
17-2071	Electrical Engineers	330	60	0.54	$102,975	$7,717
17-3026	Industrial Engineering Technicians	270	220	1.05	$49,630	-$1,739

Source: Massachusetts EOLWD, OES; author's calculations. Wages in 2013 dollars.

Figure 13

Difference in occupational earnings for workers in Computers and Electronics v. regional average wage across all workers



Source: MA EOLWD, OES; author's calculations. Wages in 2013 dollars.

assemblers. Workers that have high knowledge and skill requirements or that require significant post-secondary education and training, such as software developers, engineers, and chemists are paid much higher wages, in some cases almost four times the lowest earning core occupation; team assemblers (Figure 13). This mirrors what we found for the subsector in other regions—a high wage premium for occupations requiring more formal education and higher degree requirements. In general, occupation-specific wages have increased since 2001 in a number of core labor pool occupations, though several lower skilled and paying jobs saw wages

actually decrease over the period; most likely a result of the downward wage pressure from layoffs and job losses since 2001 (Table 7).

Fabricated Metals and Machinery

Relative to other subsectors in the Commonwealth, Fabricated Metals and Machinery has the highest concentration of 'production' oriented occupations: including workers that use machining, tools, and other tangible processes to complete work. Together they comprise about half of the total workforce in the subsector statewide. Beyond production occupations, the Fabricated Metals subsector also employs a number of engineering-based occupations.

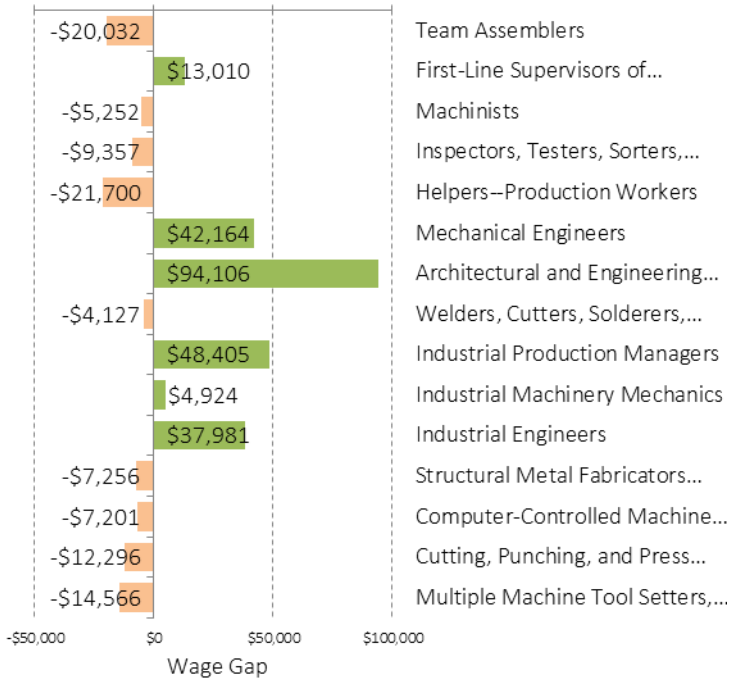
As the largest subsector in the Southeast, Fabricated Metals draws from a large potential labor pool of core occupations that are focused on machine work and engineering design occupations (Table 7). In particular, machinists are a core occupation of the subsector and are highly concentrated in the region as noted by a

Table 7
Summary Employment and Earnings Statistics, Key Occupations in Fabricated Metals and Machinery, 2012

		Employment			Real Wage	
SOC	Occupational Title	Number	Change from 01	Location Quotient	Per worker	Change from 01
51-2092	Team Assemblers	2,760	-1,990	0.72	$28,513	-$3,008
51-1011	First-Line Supervisors of Production and Operating Workers	2,260	-950	1.04	$61,555	$3,269
51-4041	Machinists	1,730	110	1.17	$43,293	-$4,701
51-9061	Inspectors, Testers, Sorters, Samplers, and Weighers	1,500	-360	0.86	$39,188	$2,939
51-9198	Helpers--Production Workers	1,420	-310	0.88	$26,845	-$1,796
17-2141	Mechanical Engineers	1,030	560	1.07	$90,709	$8,643
11-9041	Architectural and Engineering Managers	820	270	1.14	$142,651	$19,134
51-4121	Welders, Cutters, Solderers, and Brazers	700	-100	0.56	$44,418	$4,103
11-3051	Industrial Production Managers	600	-80	0.98	$96,950	$5,923
49-9041	Industrial Machinery Mechanics	560	30	0.49	$53,469	$2,072
17-2112	Industrial Engineers	550	180	0.65	$86,526	$6,488
51-2041	Structural Metal Fabricators and Fitters	430	-	1.44	$41,289	-
51-4011	Computer-Controlled Machine Tool Operators, Metal and Plastic	430	240	0.81	$41,344	$801
51-4031	Cutting, Punching, and Press Machine Setters, Operators, and Tenders, Metal and Plastic	350	-860	0.50	$36,249	-$640
51-4081	Multiple Machine Tool Setters, Operators, and Tenders, Metal and Plastic	320	-	0.98	$33,979	-

Source: Massachusetts EOLWD, OES; author's calculations. Wages in 2013 dollars.

Figure 14
Difference in occupational earnings for workers in Fabricated Metals and Machinery v. regional average wage across all workers



Source: MA EOLWD, OES; author's calculations. In 2013 dollars.

location quotient of 1.17. Likewise, structural metal fabricators and fitters are also highly concentrated in the region (location quotient = 1.44). Other occupations common to this sector are somewhat under-represented in the Southeas: most notably, inspectors; computer-controlled machine tool operators; cutting, punching, and press operators; welders, cutters, solderes, and brazzers; and industrial machine mechanics.

Following statewide patterns for the Fabricated Metals subsector, average wages in the core occupational labor pool are lower than the regional average. The key exceptions are engineers and managerial occupations—who make considerably more (Figure 14). Wage growth is somewhat mixed, although most occupations have seen some real wages increase since 2001 (Table 7). The highest paying occupations (engineers and managers) also are those that experienced the highest gains in their real earnings.

Food Processing and Production

The Food Processing and Production subsector has a diverse occupational mix that is at times characteristic of other forms of manufacturing and at times more akin to food services. Many of the core occupations in the Food Processing and Production subsector involve industrial food preparing and processing and are somewhat specialized to the subsector. These include bakers; food batchmakers; meat, poultry and fish cutters; and food-related machinery operators. The subsector is somewhat underrepresented in the Southeast, although it still comprises almost 17% of all Advanced Manufacturing employment in the region.

Table 8 presents employment and wage data for the occupations in the Food Processing subsector's core labor pool. Similar to the other subsectors, Food Processing draws upon the large regional pool of team assemblers and first-line supervisors, as well as workers that package and deliver products. Occupations

Table 8

Summary Employment and Earnings Statistics, Key Occupations in Food Processing and Production, 2012

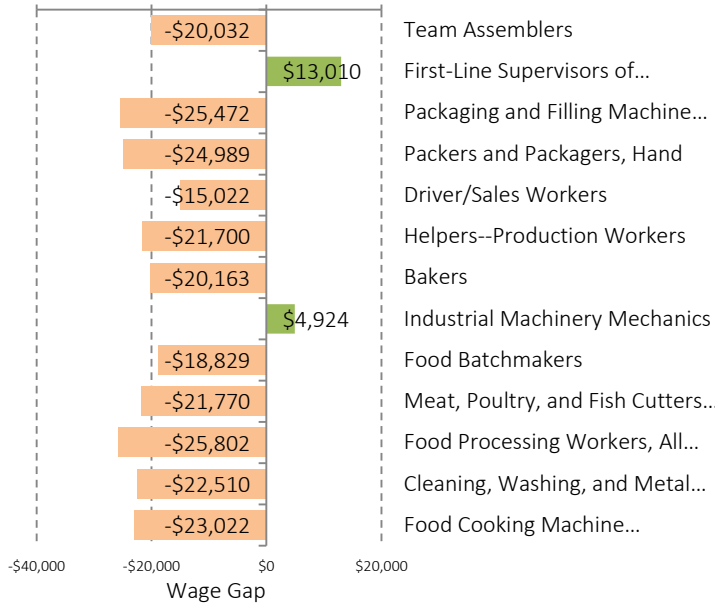
		Employment			Real Wage	
SOC	Occupational Title	Number	Change from 01	Location Quotient	Per worker	Change from 01
51-2092	Team Assemblers	2,760	-1,990	0.72	$28,513	-$3,008
51-1011	First-Line Supervisors of Production and Operating Workers	2,260	-950	1.04	$61,555	$3,269
51-9111	Packaging and Filling Machine Operators and Tenders	2,260	1,970	1.61	$23,073	-$7,270
53-7064	Packers and Packagers, Hand	2,200	-1,550	0.87	$23,556	-$2,888
53-3031	Driver/Sales Workers	1,470	1,090	0.98	$33,523	-$16,799
51-9198	Helpers--Production Workers	1,420	-310	0.88	$26,845	-$1,796
51-3011	Bakers	800	500	1.33	$28,382	-$151
49-9041	Industrial Machinery Mechanics	560	30	0.49	$53,469	$2,072
51-3092	Food Batchmakers	190	170	0.49	$29,716	-$586
51-3022	Meat, Poultry, and Fish Cutters and Trimmers	180	-130	0.30	$26,775	-$6,300
51-3099	Food Processing Workers, All Other	100	-	0.70	$22,743	-
51-9192	Cleaning, Washing, and Metal Pickling Equipment Operators and Tenders	70	40	1.14	$26,035	-$1,109
51-3093	Food Cooking Machine Operators and Tenders	60	-230	0.47	$25,523	-$2,491

Source: Massachusetts EOLWD, OES; author's calculations. Wages in 2013 dollars.

that are more specific to the subsector—food batchmakers; meat, poultry, and fish cutters and trimmers; and food cooking and machine operators—are generally underrepresented in the region. Bakers and packaging machine operators are key exceptions. They are both more abundant in the region than what might be expected given national employment patterns.

Figure 15

Difference in occupational earnings for workers in Food Processing and Production v. regional average wage across all workers



Source: MA EOLWD, OES; author's calculations. Wages in 2013 dollars.

Following what we have seen for regions and the state, occupational wages in the Food Processing subsector are below average (Figure 15). Supervisors and industrial machinery mechanics are notable exceptions. These are also the only two occupations posting real earnings growth since 2001. Otherwise, average wage levels have declined across the board, with the largest declines realized in occupations that are heavily underrepresented in the region (Table 8).

Medical Equipment and Supplies

A majority of core occupations in Medical Equipment and Supplies are production-oriented or engineering -based occupations. The subsector shares a number of occupations with Fabricated Metals and Machinery, such as engineers, machinists, and other types of machine operators, while a handful of core occupations are specific to the subsector.

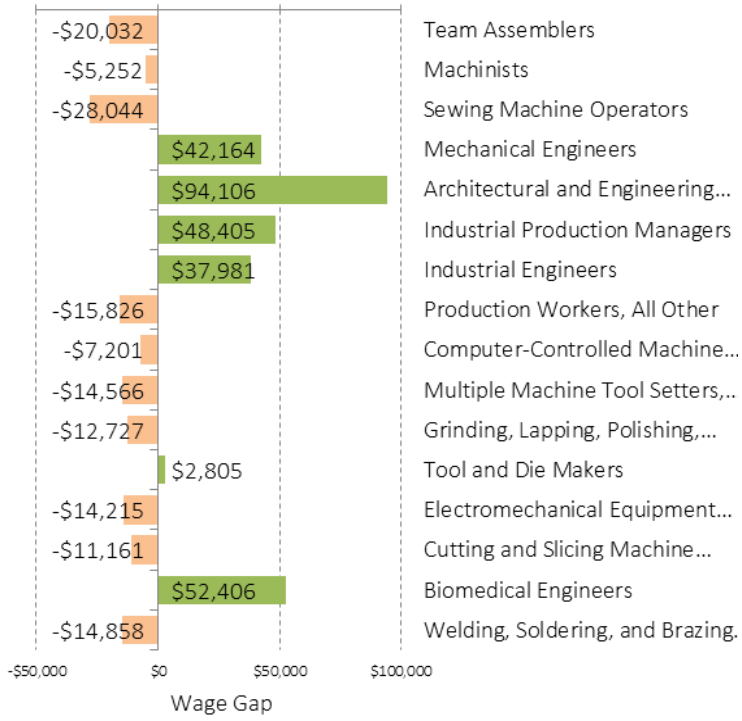
Diverging from other regions, Medical Equipment and Supplies comprises a relatively large share of Advanced Manufacturing employment in the Southeast and is a primary industrial specialization. Medical Equipment also draws from a diverse set of core occupations, with considerable overlap in its core occupations with other Advanced Manufacturing subsectors — Fabricated Metals, Chemicals and Plastics, and Computers and Electronics (Table 10). Some of these common occupations include machinists and other types of machine operators, biomedical and various engineers, electromechanical equipment assemblers, and tool and die makers. The sector also draws upon sewing machine operators to some extent, which

Table 9
Summary Employment and Earnings Statistics, Key Occupations in Medical Equipment and Supplies, 2012

		Employment			Real Wage	
SOC	Occupational Title	Number	Change from 01	Location Quotient	Per worker	Change from 01
51-2092	Team Assemblers	2,760	-1,990	0.72	$28,513	-$3,008
51-4041	Machinists	1,730	110	1.17	$43,293	-$4,701
51-6031	Sewing Machine Operators	1,300	-330	2.39	$20,501	-$5,252
17-2141	Mechanical Engineers	1,030	560	1.07	$90,709	$8,643
11-9041	Architectural and Engineering Managers	820	270	1.14	$142,651	$19,134
11-3051	Industrial Production Managers	600	-80	0.98	$96,950	$5,923
17-2112	Industrial Engineers	550	180	0.65	$86,526	$6,488
51-9199	Production Workers, All Other	520	-230	0.62	$32,719	$7
51-4011	Computer-Controlled Machine Tool Operators, Metal and Plastic	430	240	0.81	$41,344	$801
51-4081	Multiple Machine Tool Setters, Operators, and Tenders, Metal and Plastic	320	-	0.98	$33,979	-
51-4033	Grinding, Lapping, Polishing, and Buffing Machine Tool Setters, Operators, and Tenders, Metal and Plastic	300	-510	1.13	$35,818	-$1,216
51-4111	Tool and Die Makers	230	-250	0.79	$51,350	-$1,261
51-2023	Electromechanical Equipment Assemblers	200	-240	1.05	$34,330	$5,496
51-9032	Cutting and Slicing Machine Setters, Operators, and Tenders	200	-140	0.92	$37,384	-$1,408
17-2031	Biomedical Engineers	170	-	2.36	$100,951	-
51-4122	Welding, Soldering, and Brazing Machine Setters, Operators, and Tenders	120	70	0.63	$33,687	-$10,622

Source: Massachusetts EOLWD, OES; author's calculations. Wages in 2013 dollars.

Figure 16
Difference in occupational earnings for workers in Medical Equipment and Supplies v. regional average wage across all workers



Source: MA EOLWD, OES; author's calculations. Wages in 2013 dollars.

have a relatively large presence in the labor pool and are also heavily concentrated in the region.

With the exception of engineers and managers, average wages in Medical Equipment's core occupations trend lower than the regional average for all workers (Figure 16). Wage trends have been mixed since 2001, with many of the more specialized machine operators seeing real earnings decline while engineers and managerial workers have seen increases over the period (Table 10).

Paper and Printing

Similar to other Advanced Manufacturing sectors, about half of Paper and Printing occupations are production-oriented. The subsector is distinct by the notable presence of design- and arts-oriented workers in its set of core occupations, while engineering occupations are largely absent.

Following other subsectors, Paper and Printing draw upon a large number of general supervisory and management workers, as well as more basic, low skill helpers (Table 10). Paper and Printing shares a need for skilled machine oriented workers with other subsectors. Yet many of the remaining core occupations of the sector are distinct and highly specific to paper goods and paper production. These include printing press operators; print binding and finishing workers; prepress technicians; and paper goods machine setters; of which the first two have the largest presence and are most concentrated in the region. Again, we caution drawing conclusive trends in employment considering data limitations, yet employment in the core labor pool of Paper and Printing appears to have declined across the board, reflecting employment trends of the larger subsector since 2001. Still, the broader industrial changes occurring in this subsector of replacement by digital medias, suggests efforts to help workers adapt skills to other types of work may be advantageous from a workforce development standpoint.

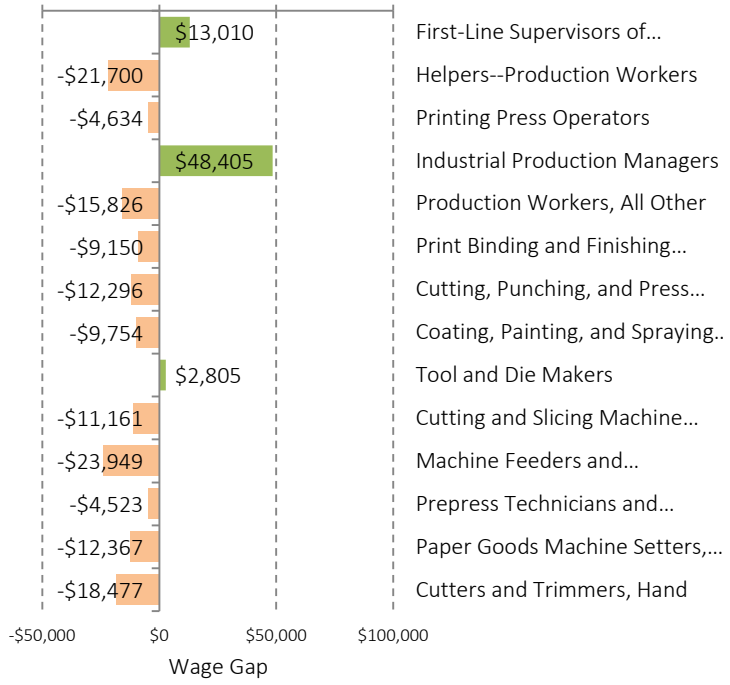
Table 10
Summary Employment and Earnings Statistics, Key Occupations in Paper and Printing, 2012

SOC	Occupational Title	Employment			Real Wage	
		Number	Change from 01	Location Quotient	Per worker	Change from 01
51-1011	First-Line Supervisors of Production and Operating Workers	2,260	-950	1.04	$61,555	$3,269
51-9198	Helpers--Production Workers	1,420	-310	0.88	$26,845	-$1,796
51-5112	Printing Press Operators	780	-	1.18	$43,911	-
11-3051	Industrial Production Managers	600	-80	0.98	$96,950	$5,923
51-9199	Production Workers, All Other	520	-230	0.62	$32,719	$7
51-5113	Print Binding and Finishing Workers	410	-	2.02	$39,395	-
51-4031	Cutting, Punching, and Press Machine Setters, Operators, and Tenders, Metal and Plastic	350	-860	0.50	$36,249	-$640
51-9121	Coating, Painting, and Spraying Machine Setters, Operators, and Tenders	250	-70	0.82	$38,791	-$1,071
51-4111	Tool and Die Makers	230	-250	0.79	$51,350	-$1,261
51-9032	Cutting and Slicing Machine Setters, Operators, and Tenders	200	-140	0.92	$37,384	-$1,408
53-7063	Machine Feeders and Offbearers	180	-180	0.45	$24,596	-$6,611
51-5111	Prepress Technicians and Workers	120	-	0.76	$44,022	-
51-9196	Paper Goods Machine Setters, Operators, and Tenders	60	-60	0.16	$36,178	-$3,676
51-9031	Cutters and Trimmers, Hand	40	-70	0.76	$30,068	-$1,907

Source: Massachusetts EOLWD, OES; author's calculations. Wages in 2013 dollars.

Wages in the Southeast region's Paper and Printing sector largely mirror those found for most other regions. That is, with the exception of managerial and supervisory occupations, they all pay less than the overall regional average (Figure 17). Similarly, most core occupations in the labor pool have seen their real wages decrease; symptomatic of the declines in the overall subsector over the last decade and a half.

Figure 17
Difference in occupational earnings for workers in Paper and Printing v. regional average wage across all workers



Source: MA EOLWD, OES; author's calculations. In 2013 dollars.

Occupational Skills and Knowledge Requirements

This section profiles the types of skills and knowledge required of Advanced Manufacturing workers in the Southeast region. We identify relevant skills by linking regional occupation employment data to the typical job requirements in 35 skill domains, as reported by the Bureau of Labor Statistics' Occupational Information Network (O*Net). As discussed in the previous section, industry-specific occupational data is not reported at the regional level. Thus, our analysis is more indicative of the skills of the overall labor force or potential labor pool, and not exclusive to workers in Advanced Manufacturing. For example, reported employment totals for industrial production managers include workers in Advanced Manufacturing as well as those working in other sectors: such as Transportation, Installation, and other areas.

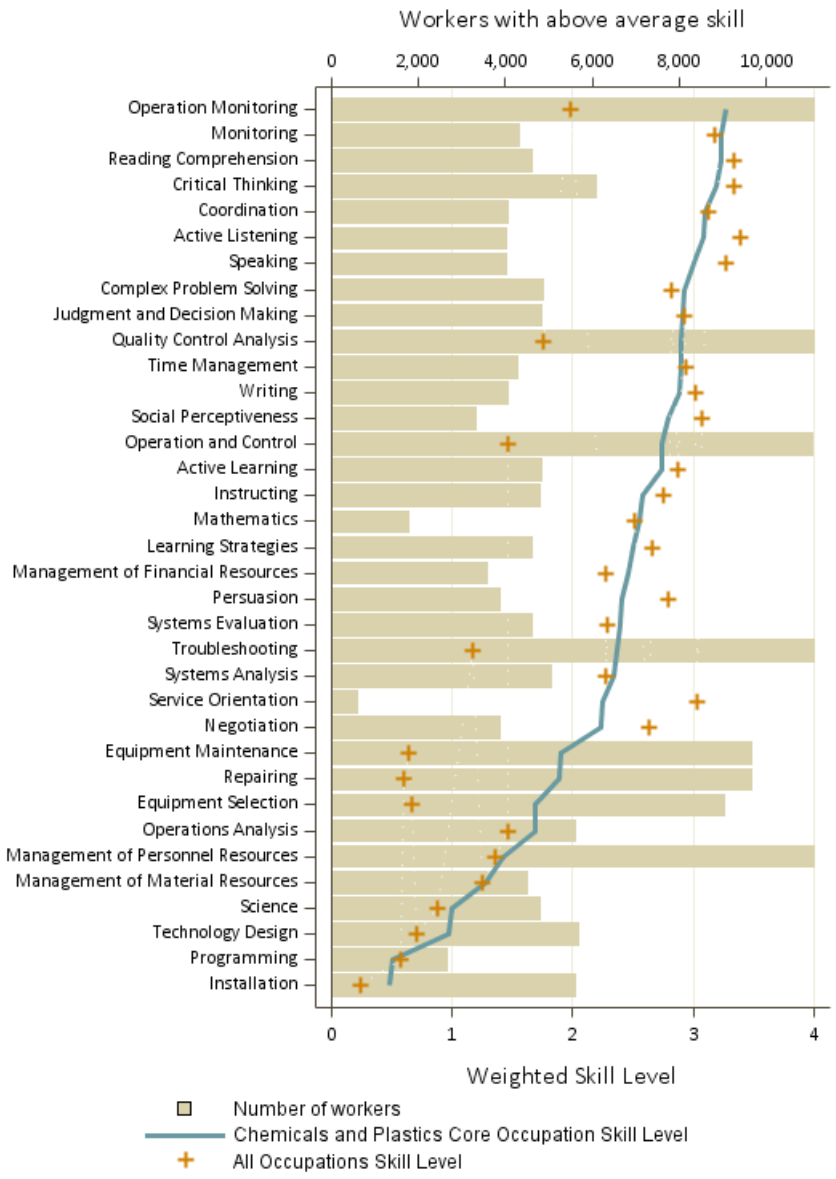
Our analysis follows a similar method used in the state level report where we calculate a weighted average skill level based upon the employment and relative skill level reported in the O*Net for each subsector's core occupations. Average skill levels are then ranked from highest to lowest (top to bottom) and indicated by the blue line in each chart labeled "subsector core occupation skill level". A plus sign indicates the regional average skill score weighted across all occupational employment in all industries as reported in the regional BLS Occupational Employment Survey data. This represents the typical level of that skill required by workers in the broader labor force. The horizontal bars indicate the number of workers in a particular subsector's core occupations that require an above average level of each skill. This helps identify strengths of potential labor pool for each subsector and Advanced Manufacturing across the Southeast region. We also consider workers' preparation requirements for core occupations, whether through post-secondary education, experience, on-the-job training, and in-plant training — each measured in the typical number of years required as a condition of entry into the occupation. The 'all occupation' regional average is indicated by a vertical bar and provides a benchmark to compare subsector knowledge requirements to the broader regional labor pool. The remainder of this section presents the skill requirements for each subsector followed by the knowledge requirements of the regional labor pool.

Chemicals and Plastics

Skill requirements in Chemicals and Plastics are more diverse relative to most other subsectors. The most prevalent skills are in the areas of quality control, equipment selection, operation and control, equipment maintenance, and repairing (see Figure 26 of state report). However, workers in Chemicals and Plastics also have high requirements of basic skills, such as reading, critical thinking, active learning, and math.

The core Chemicals and Plastics labor pool in the Southeast require skill levels similar to the general regional workforce across most domains. However, core occupations in Chemicals and Plastics tend to fall below regional averages in more specialized socially based skills such as persuasion, negotiation, and social orientation (Figure 18). The core labor pool exceeds the regional average in skills that are more technically-oriented, such equipment usage, troubleshooting, and repairing, as well as skills based on operation and quality control analysis. We find similar trends within this subsector in other regions. The highest ranking skills in the region tend to be basic learning skills, such as reading comprehension, critical thinking and active listening. Although skills related to monitoring, operation monitoring, and quality control analysis also rank high for the core labor pool. Likewise, the core labor pool for Chemicals and Plastics is comprised of a large number of workers with above average skill requirements in areas such as operations monitoring, quality control, operations and control, troubleshooting and management of personnel resources, as noted by the length of the bars in Figure 18.

Figure 18
Skill requirements in Chemicals and Plastics occupations



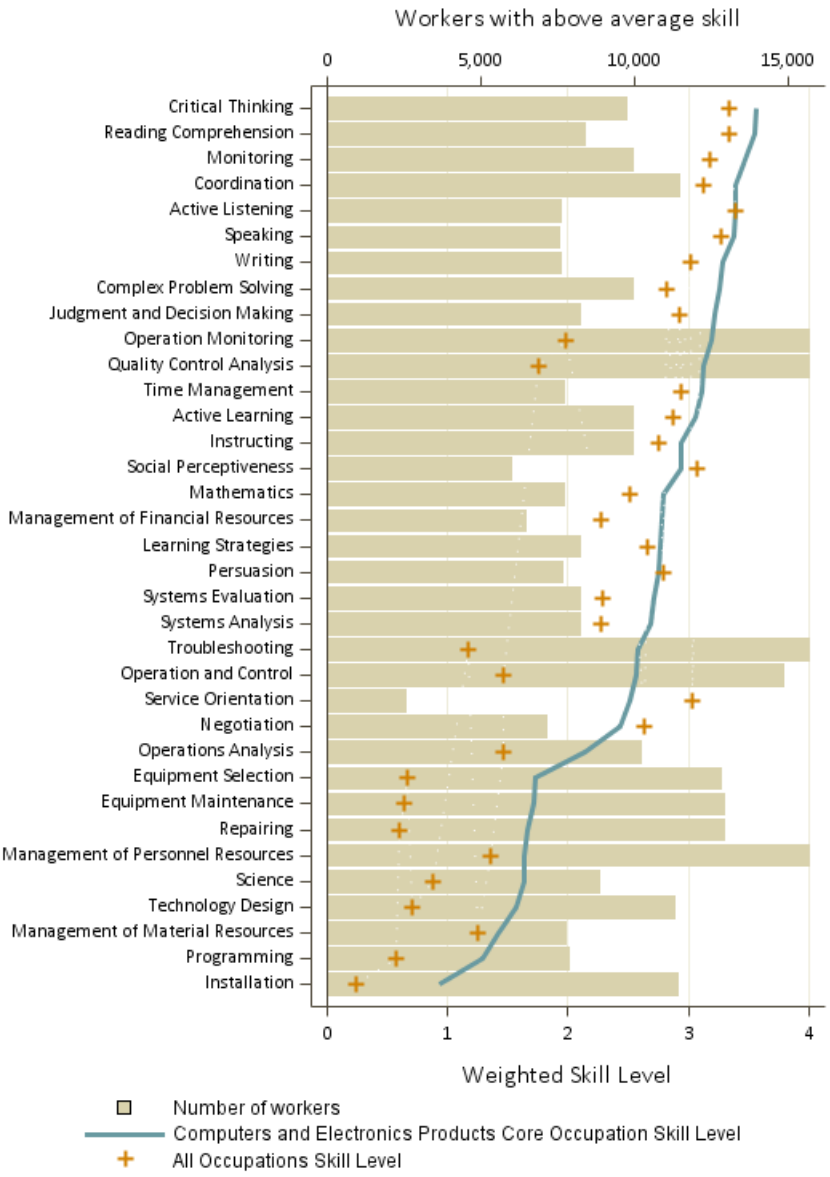
Source: MA EOLWD, OES; US BLS ONET; author's calculations.

Computers and Electronics

The core workforce of Computers and Electronics have the highest and most diverse skill requirements of the six subsectors. In line with the state, the skill requirements of the region's core labor pool exceed the general regional labor force across most of the 35 skill domains. Similar to Chemicals and Plastics, workers

in Computers and Electronics have high skill requirements in skills that facilitate the acquisition and processing of new knowledge and rather low requirements in service and social perceptiveness, and negotiation (Figure 19).

Figure 19
Skill requirements in Computers and Electronics occupations



Source: MA EOLWD, OES; US BLS ONET; author's calculations.

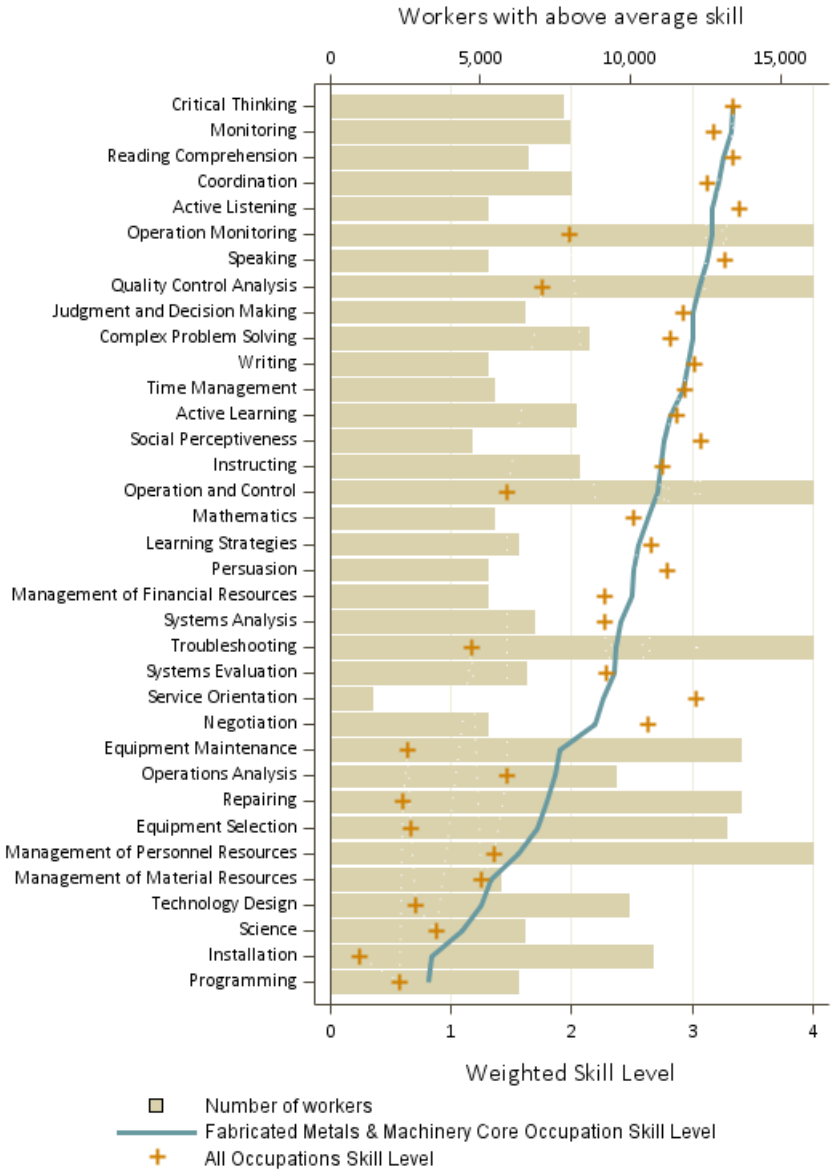
The core labor pool has somewhat higher average skill levels across just about all skill domains, except for more intensive social and service oriented skills—patterns similar to the state and most other regions in Computers and Electronics. The skills that rank highest are all directly related to basic learning and knowledge acquisition. In particular, are the highly ranked critical thinking, reading, and basic communication skills that facilitate the uptake and transmission of worker knowledge. There is an abundant number of workers in the regional labor pool in occupations with above average requirements in a number of key skill domains, most notably operation monitoring, quality control, troubleshooting, management of personnel resources, and operation and control. Relative to other sectors, the potential core labor pool of Computers and Electronics are highly skilled across most all skill domains, which suggests a strong pool of workers to both meet firm demands and to transfer skills across subsectors or to other related industries.

Fabricated Metals and Machinery

In our state level study, we found that the highest ranking skills in Fabricated Metals and Machinery are primarily technical and technological—operations monitoring, monitoring, quality control, and operations. In addition, a number of key decision making and information-processing skills also appear among those requiring high levels, such as critical thinking, reading comprehension, problem solving, and judgment.

For the most part, the core labor pool in the Southeast possess skill levels commensurate with other occupations in the region. The highest ranking skills include basic learning skills, as well as monitoring and control related. Following similar patterns of other subsectors in Advanced Manufacturing, the subsector's core labor pool has much higher levels in the skill domains related to equipment usage, repairing, and quality control analysis. The region also boasts a relatively high number of workers with above average skills in these more technically-oriented skill sets. The core labor pool is less abundant in occupations requiring more socially and service oriented skills—which tend to be less valued in the subsector, anyway. In general, we see a lot of similarity in the skill profile in the Fabricated Metals subsector and other key regional subsectors. This suggests considerable scope for providing opportunities for shared labor pooling or training programs that may benefit employers and workers in a number of different industries.

Figure 20
Skill requirements in Fabricated Metals and Machinery occupations

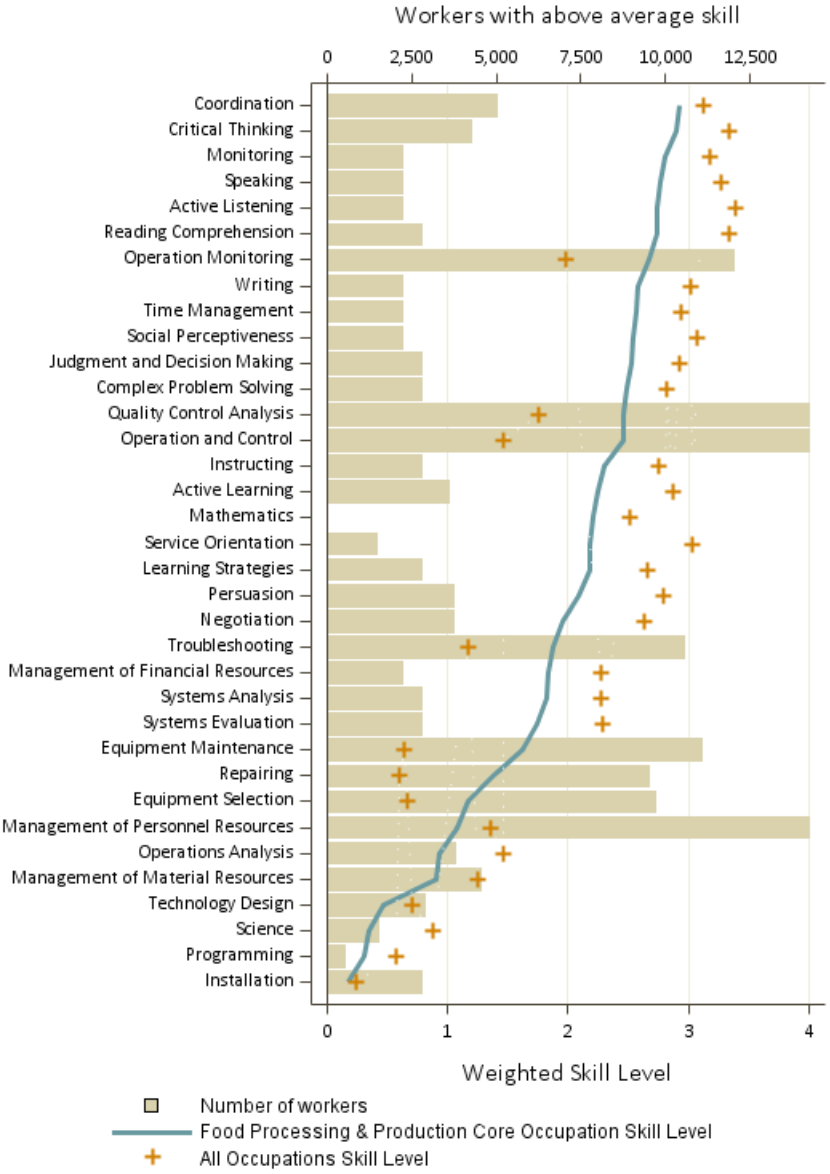


Source: MA EOLWD, OES; US BLS ONET; author's calculations.

Food Processing and Production

On the whole, Food Processing and Production has few high-level skill requirements, and is characteristic of more traditional forms of low-skilled, routine forms of production than we typically associate with Advanced Manufacturing. There are also few workers in occupations requiring an above average level of skills. The most prevalent skills are in areas related to operations control and monitoring and equipment, while skills more prevalent in other subsectors such as basic learning and complex reasoning are much less required.

Figure 21
Skill requirements in Food Processing & Production occupations



Source: MA EOLWD, OES; US BLS ONET; author's calculations.

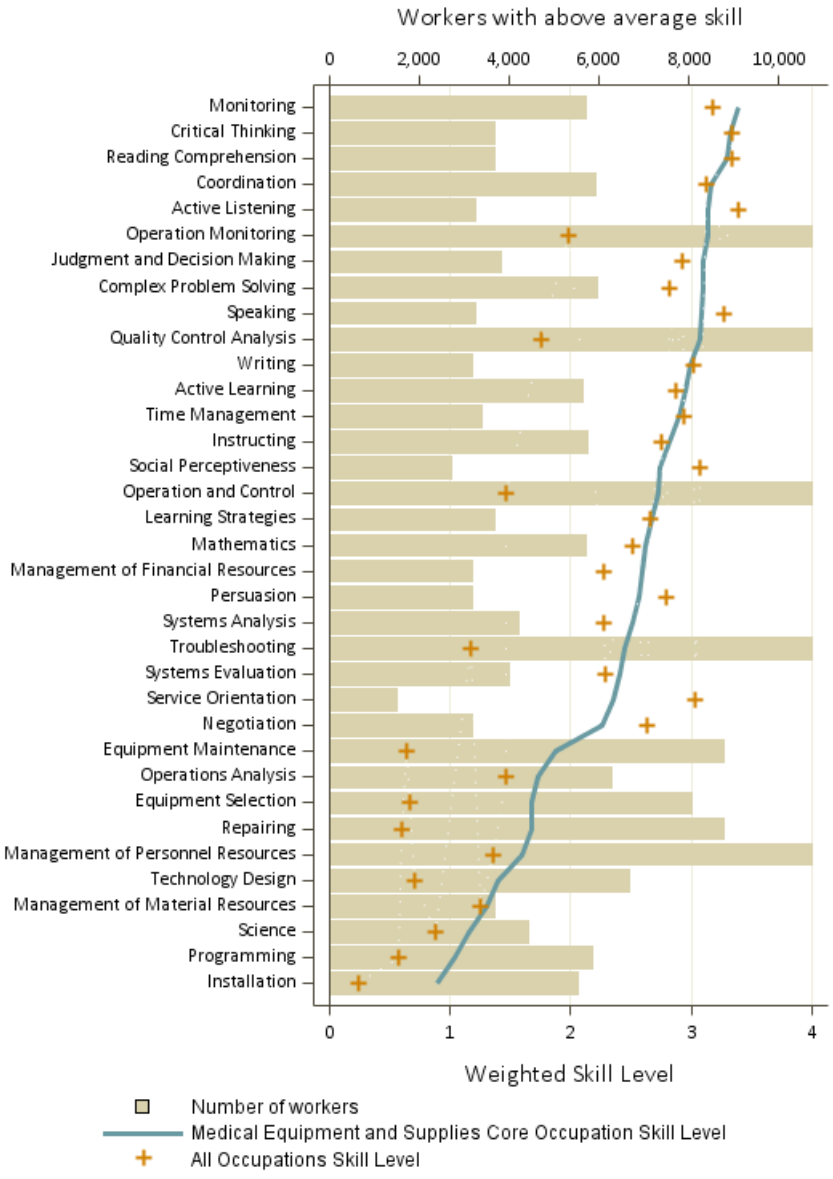
The subsector labor pool in the Southeast region is somewhat reflective of these characteristics. With the exception of a handful of skills related to equipment, operations, and quality control, average skill requirements of the overall regional labor force are significantly higher than for the subsector's core labor pool (Figure 21). The core skill mix in this subsector is quite distinct from others in Advanced Manufacturing. But given the size of the subsector and the number of potential workers in the core labor pool, the subsector might benefit from training programs directed at highly specialized skills and core occupational groups in the subsector, such as bakers and food batchmakers, which are not common to other subsectors and are generally not well reflected in generic skill categories.

Medical Equipment and Supplies

Medical Equipment and Supplies is the smallest of the six subsectors in both the state and the region. Yet it has relatively high skill requirements across a number of technical, basic, and problem solving skill domains. No single or small set of skills seem to dominate the Medical Equipment workforce. Rather, there are many workers in occupations requiring above average skill levels and the range of skills represented are quite diverse. Among the most prominent skills are operation and control, instructing, quality control, technology design, equipment selection, and coordination.

In the Southeast region, the core labor pool for Medical Equipment and Supplies has average skill levels somewhat in line with the regional average, with the exception of a handful of skills that are more advanced social and service oriented skills, as well as the basic communication skills of speaking and listening (Figure 22). The highest ranking skills are reflective of a diverse skill set and include monitoring, critical thinking, reading, judgment and decision making, and coordination. Taken together, this suggests that workers must be adept in a variety of thinking and manual skills. The core labor pool also has a relatively high number of workers with above average skills in quality control, troubleshooting and other monitoring and control skills which provide a large pool of workers to draw from.

Figure 22
Skill requirements in Medical Equipment and Supplies occupations



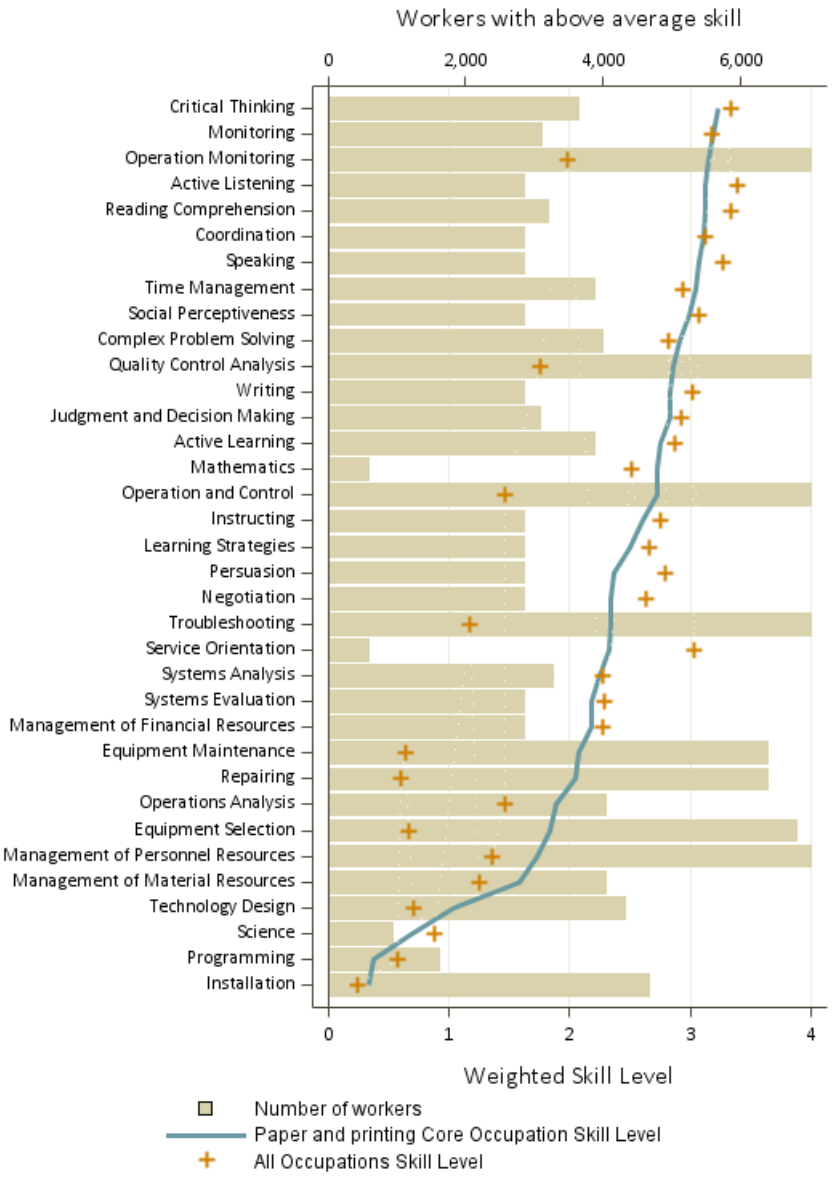
Source: MA EOLWD, OES; US BLS ONET; author's calculations.

Paper and Printing

In the state level analysis, the skills profile for the Paper and Printing subsector was characterized as a blend of Fabricated Metals and Machinery and Food Processing and Production in that most workers use production-oriented skills but on the whole workers tend to have lower skill requirements.

In the Southeast region, the highest average skill levels are in critical thinking, monitoring, operation monitoring, listening, reading, and coordination—reflecting the blended nature of the occupational skill requirements in the subsector (Figure 23). This is somewhat similar to the skill profile of the core labor pool in Medical Equipment and Supplies. In general, average skill levels mirror the overall regional labor pool, although the core labor pool has average skill requirements significantly higher in quality control analysis, operation and control, troubleshooting, and various equipment oriented skills. These types of skills are particularly important to the large number of machine operators and similar workers in the subsector core labor pool. The core labor pool has a relatively high number of workers with above average levels in skills that are operation oriented (monitoring and control), equipment management, quality control and troubleshooting.

Figure 23
Skill requirements in Paper and Printing occupations



Source: MA EOLWD, OES; US BLS ONET; author's calculations.

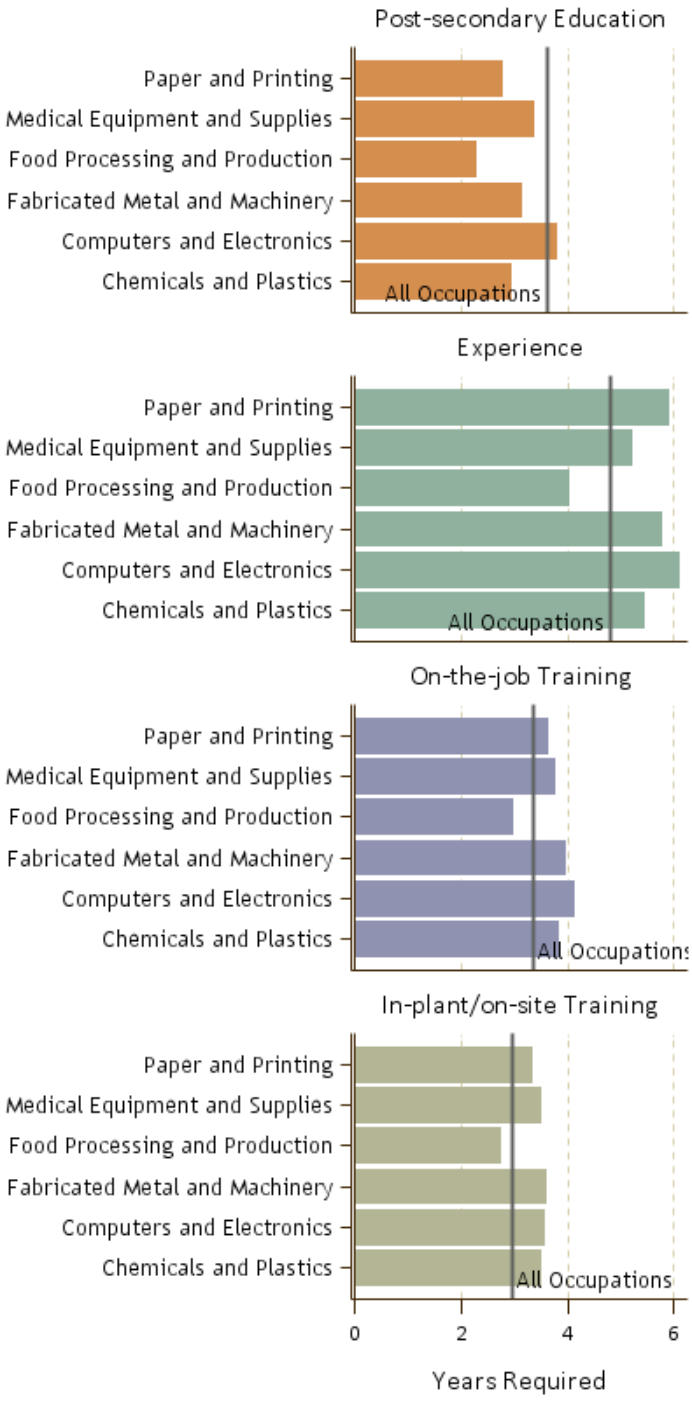
Experience, Education and Training Requirements

Figure 24 presents the average education and training requirements for the six subsectors in the Southeast region—measured as the average number of years typically required by the core occupations of each subsector. Training requirements within each subsector are almost identical to the state level analysis and generally similar across regions. This implies that the demands of industry generally transcend geography.

Computers and Electronics has both the highest average education and experience requirements, requiring just under 4 years of schooling and at least 6 years of prior industry experience. The other core subsectors in the Southeast are less reliant on formal education, but have high requirements for previous experience.

A similar story is found for on-the-job and in-plant training requirements, for which all but Food Processing have above average requirements. In general, we find occupational requirements in the Southeast region's Advanced Manufacturing subsector to follow state level averages where emphasis for knowledge acquisition is rooted in more applied forms of knowledge uptake, such as learning-by-doing, as opposed to strictly formal educational training. Training and workforce development programs may favor apprenticeships, internships and other mentoring programs as a means for introducing entry-level workers to the types of tactile knowledge favored by employers.

Figure 24



Source: Massachusetts EOLWD, OES; US BLS ONET; author's calculations.

Profile of the Advanced Manufacturing Workforce

This final section looks at the people that work in the Advanced Manufacturing sector of the Southeast region in terms of their race, gender, citizenship status, income, education, and commuting patterns. As in the state report, our demographic profile heavily relies on information from the American Community Survey Public Use Microsample (ACS PUMS) — a representative household survey conducted by the U.S. Census Bureau. It is important to keep in mind that the ACS PUMS is a sample, and not a full census count, and as such is prone to error. This is especially true in smaller regions and/or for analysis based on finely detailed subject categories where there is likely to be few survey respondents. While we provide some detailed estimates in Table 11, we warn the reader against interpreting our results as highly precise estimates, but rather indicative of general tendencies and trends.

As a final note: our demographic profiles are based on slightly different regional definitions than the rest of the study. This is because the ACS PUMS does not use standard geographic jurisdictions (e.g. towns, counties, and metropolitan areas) but rather its own jurisdictions called PUMAs (Public Use Micros-ample Areas). While we deliberate design each PUMA-based region to closely match our standard (WIA-based) regional boundaries, some differences were unavoidable (Figure 25). In the case of the Southeast, the two regional delineations are very close, differing only by the inclusion of a single town.

Figure 25
PUMS-Based Study Region Boundaries used in Demographic Analysis

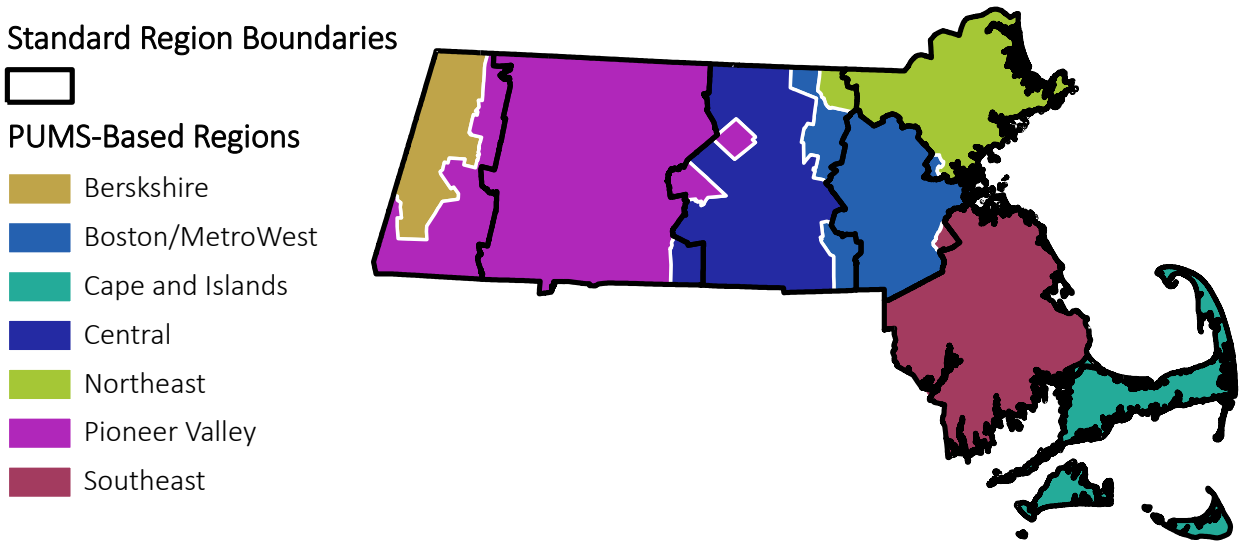


Table 11

Summary, Demographic Profile of the Advanced Manufacturing Workforce, Southeast Region

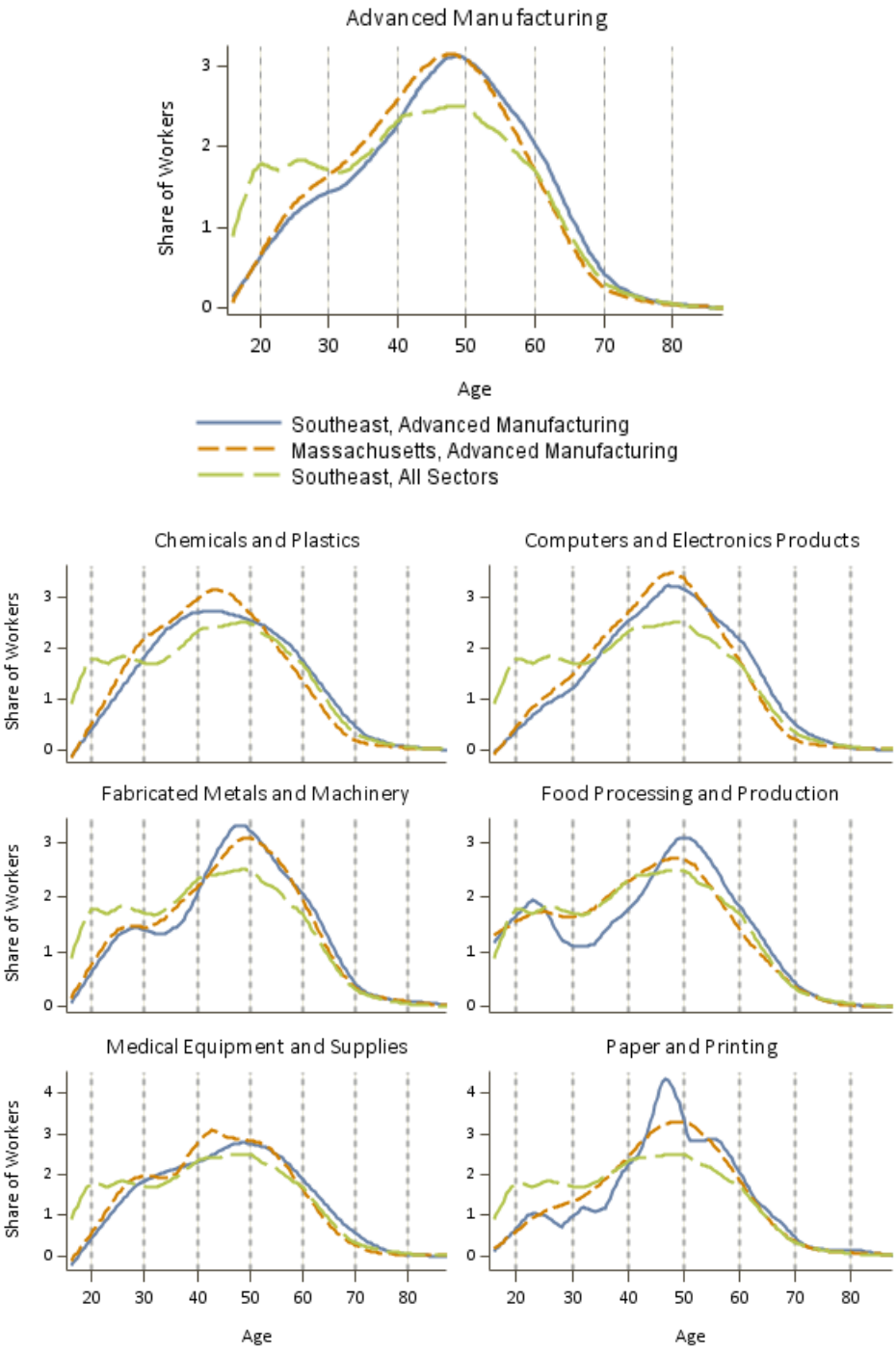
	Advanced Manufacturing	Chemicals and Plastics	Computers and Electronics Products	Fabricated Metals & Machinery	Food Processing & Production	Medical Equipment and Supplies	Paper and printing	All Industries
Age								
Median	47.0	44.0	48.0	48.0	46.0	46.0	48.0	43.0
Under 25 years old	6%	4%	4%	6%	16%	3%	7%	14%
25 to 39 years	24%	33%	23%	21%	18%	30%	17%	28%
40 to 54 years	43%	39%	44%	45%	42%	41%	47%	36%
55 years or older	27%	24%	29%	28%	24%	26%	29%	22%
Race								
White	83%	80%	84%	90%	81%	77%	84%	88%
African American	6%	8%	4%	6%	11%	6%	5%	6%
Asian	7%	9%	8%	3%	3%	13%	6%	3%
Other	3%	1%	4%	0%	4%	3%	4%	2%
More than one race	1%	1%	0%	1%	2%	1%	1%	1%
Female	32.3%	37.8%	34.0%	22.7%	36.1%	41.3%	24.2%	50.7%
Place of Birth								
Massachusetts	55%	46%	52%	64%	55%	46%	67%	65%
Other New England	8%	10%	9%	7%	6%	8%	7%	8%
Other United States	13%	20%	13%	11%	11%	18%	8%	12%
Outside United States	24%	24%	26%	18%	28%	29%	17%	15%
Median Income (2012 dollars)								
Family Income	$85,000	$91,759	$87,606	$80,213	$81,023	$90,460	$71,394	$80,707
Personal Income	$45,738	$50,820	$48,000	$43,550	$39,319	$49,666	$40,656	$36,871
Wage and Salary Income*	$42,537	$50,639	$45,000	$42,000	$34,105	$46,755	$40,000	$32,262
Educational Attainment								
Less than High School	13%	13%	12%	14%	19%	11%	11%	8%
High School Diploma or GED	32%	20%	27%	44%	30%	27%	43%	28%
Associates Degree or Some College	23%	26%	25%	23%	23%	21%	23%	29%
Bachelors Degree or Higher	31%	41%	36%	19%	27%	41%	23%	36%
Commuting								
Ave. Travel Time to Work (mins)	26.2	26.4	26.8	24.7	23.8	29.0	25.5	23.3
Region/State of Primary Residence								
Berskshire	0%	0%	0%	0%	0%	0%	0%	0%
Boston MetroWest	10%	9%	10%	7%	6%	19%	8%	8%
Cape and Islands	1%	0%	2%	1%	2%	0%	2%	1%
Central	1%	1%	1%	2%	0%	1%	1%	1%
Northeast	2%	3%	1%	2%	3%	2%	1%	2%
Pioneer Valley	0%	0%	0%	0%	0%	0%	0%	0%
Southeast	75%	70%	72%	81%	76%	68%	83%	82%
Other State	11%	17%	14%	7%	14%	10%	5%	6%

*Note: Wage and Salary Income reported in the ACS is different than the Total Wage and Salary reported from the Bureau of Labor Statistics and State Affliates. The ACS is based on a much smaller sample of the workforce and does not include the dollar value of benefits as reported in BLS employer surveys.

Age

The Advanced Manufacturing workforce of the Southeast region is slightly older than that of the Commonwealth. The wage of the median Advanced Manufacturing worker in the Southeast is 47 years old—two years older than the state (Table 11). The Southeast also has far more workers in their fifties and sixties and far fewer currently in their 30's (Figure 26). Within the next ten years, close to 27 percent of the region's Advanced Manufacturing workforce will reach the traditional retirement age of 65 years. Within the next twenty years, that portion will jump to nearly 60 percent.

Figure 26
Age Distribution of the Advanced Manufacturing Workforce



Source: US Census Bureau, American Community Survey Public Use Micro Sample 2008-2012, Author's Calculations

The age distributions for the six subsectors in the Southeast all show some indication of an impending labor shortage (Figure 26, lower portion). The three subsector most at risk are Computers and Electronics Products, Fabricated Metals, and Paper and Printing. All three have a median age of 48 years and over 28 percent of the workforce currently age 55 and higher. Food

Processing and Production, Chemicals and Plastics, and Medical Equipment and supplies face a less immediate risk. They are generally "younger" and have a smaller share of their workforce 55 years or older.

Race, Gender and Nativity

The workforce of Southeast Advanced Manufacturing is slightly more racially diverse than the general population (Table 11). Eighty-three percent of the Advanced Manufacturing workforce is white, compared to the regional population share of 88%. Asians are particularly well represented relative to their size in the overall workforce, with the remainder of the major racial groups in approximate proportion to their overall presence in the workforce. Three subsectors stand out as being especially diverse: Medical Equipment and Supplies, Food Processing and Production, and Chemicals and Plastics. Fabricated Metals has the smallest share of its workforce classified as racial minorities—although it is still representative of the diversity (or lack thereof) of the region's overall workforce.

Advanced Manufacturing in the Southeast area also has a fairly substantial share of foreign born workers—24% compared to the overall regional average of 15%. Every individual subsector exceeds the average of foreign born workers. Medical Equipment and Supplies and Food Processing have a particularly large share of foreign born workers (29% and 28%, respectively). Roughly 55% of those currently working in Advanced Manufacturing are Massachusetts natives, with particularly high shares of locals found in Fabricated Metals and Paper and Printing.

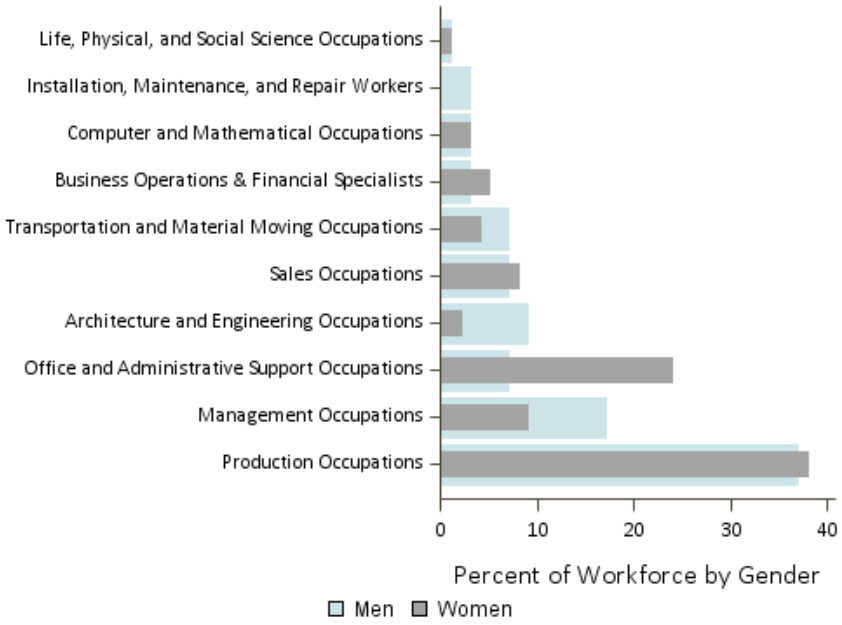
Advanced Manufacturing is also predominantly male. Women comprise only 32% of the Southeast region's Advanced Manufacturing workforce compared to 51% of the overall regional workforce. While women are underrepresented in every subsector, the largest gender divide is in Fabricated Metals where females account for only 23% of the workforce. The largest share of the women who work in Advanced Manufacturing can be found in production occupations (38%)—a share just slightly higher than men (37% Figure 27). However, because there are so fewer women that work in Advanced Manufacturing, the actual number of women in production jobs is only half the number of men. Women are also heavily specialized in back office functions: Administrative and Office support, Business Operations and Financial Specialists, and Sales. Office and Administrative Support occupations is the only occupation group where women actually outnumber the men. Men are far more prominent than women in architecture and engineering and managerial occupations.

Educational Attainment

The Advanced Manufacturing workforce of the Southeast region have relatively less post-secondary education than their peers in other areas of the Commonwealth. A majority (55%) of its workers have at least some college-level education (Table 11). This is a full 11 percentage points lower than the state share for the sector, and 10 percentage points lower that the overall regional average.

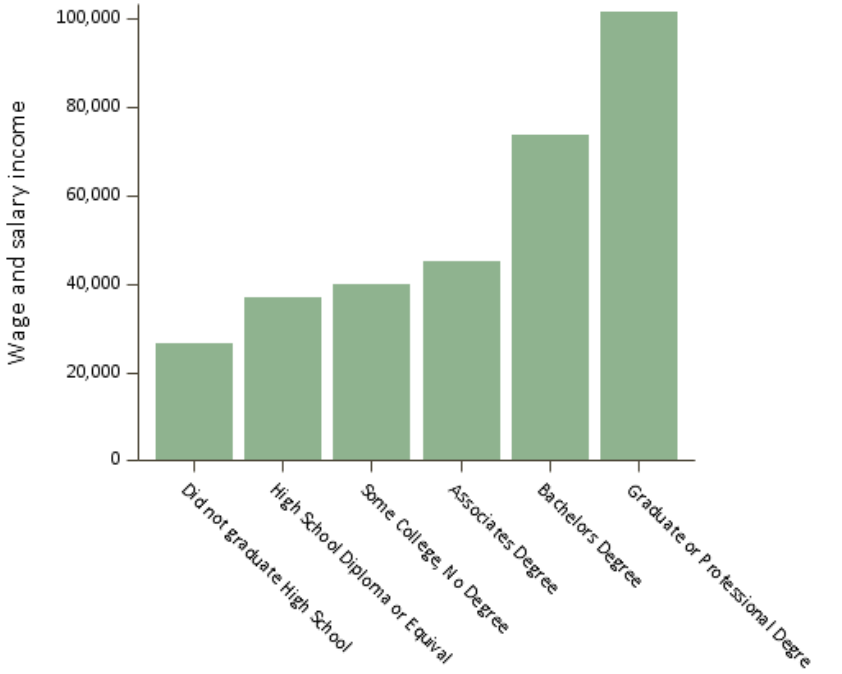
Those with higher degrees also earn considerably more than those without (Figure 28). There is a particularly large pay increase for those earning a Bachelor's degree compared to those with an Associate's degree or some college. There is a second jump for those attaining Graduate degrees. Some of these variations are due to differences in prevailing subsector and occupational wage levels—some subsectors require occupations that have higher educational requirements and these also tend to pay more than other subsectors.

Figure 27
Gender Differences by Major Occupation Groups in Advanced Manufacturing



Source: US Census Bureau, American Community Survey Public Use Micro Sample 2008-2012, Author's Calculations

Figure 28
Median Wage and Salary Earnings by Education, Advanced Manufacturing

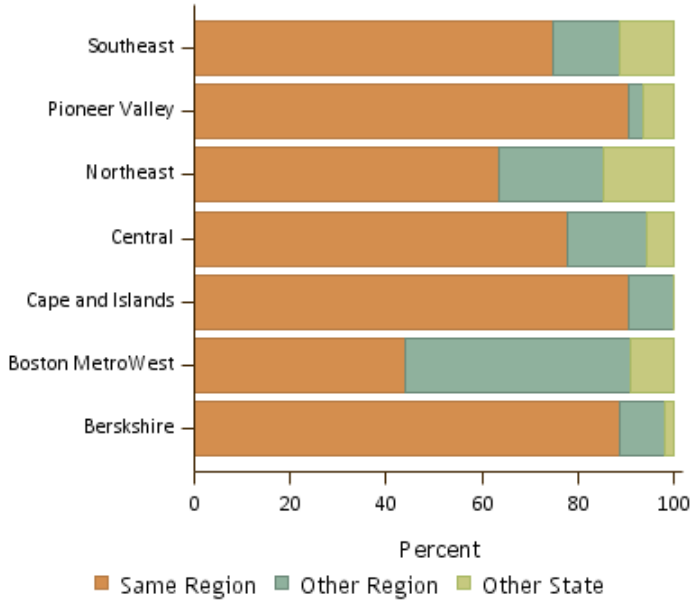


Source: US Census Bureau, American Community Survey Public Use Micro Sample 2008-2012, Author's Calculations

Residency and Commuting Patterns

Three quarters of the people who work in Advanced Manufacturing in the Southeast also live in the region (Figure 29). Four regions have higher within region residency rates, three have lower. Among those that live elsewhere in the state, most commute in from the Boston/ Metrowest region to the north. Southeast workers are also somewhat more likely to commute in from out-of-state, which is not surprising given its proximity to Rhode Island and Connecticut. The average travel time to work is 26 minutes, just slightly lower than the state average of 30 minutes.

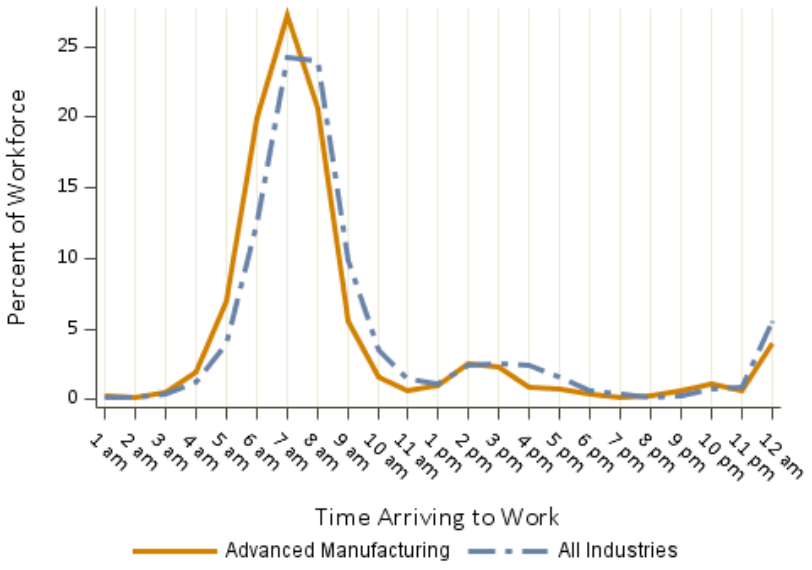
Figure 29
Place of Residence by Region



Source: US Census Bureau, American Community Survey Public Use Micro Sample 2008-2012, author's calculations

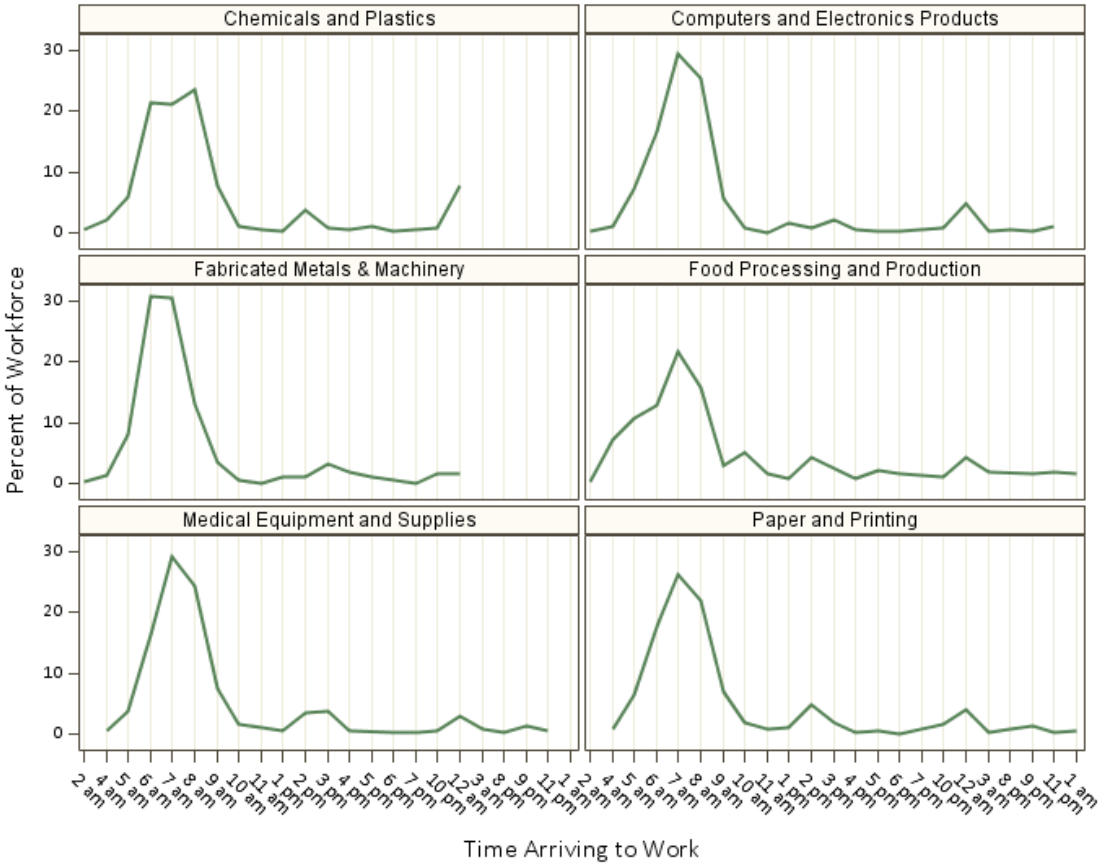
The typical worker in Advanced Manufacturing enjoys a relatively standard work day, with arrival times peaking between 6:00 and 8:00 am (Figure 30). This is slightly earlier than the typically morning peak of 7:00 to 8:00 am. The same basic pattern holds for the individual subsectors (Figure 31).

Figure 30
Time Arriving to Work



Source: US Census Bureau, American Community Survey Public Use Micro Sample

Figure 31
Time Arriving to Work, by Advanced Manufacturing Subsector, Southeast Region



Source: US Census Bureau, American Community Survey Public Use Micro Sample 2008-2012, author's calculations

Appendices

Appendix A

Advanced Manufacturing Subsector Definitions

Chemical & Plastics (incl. Pharmaceuticals)

NAICS	Description
3251	Basic chemical
3252	Resin, synthetic rubber, and artificial synthetic fibers
3253	Pesticide, fertilizer, and other agricultural chemical
3254	Pharmaceutical and medicine
3255	Paint, coating, and adhesive
3256	Soap, cleaning compound, and toilet preparation
3259	Other chemical product and preparation
3261	Plastics product

Fabricated Metal Products & Machinery

NAICS	Description
3321	Forging and stamping
3322	Cutlery and handtool
3323	Architectural and structural metals
3324	Boiler, tank, and shipping container
3325	Hardware
3326	Spring and wire product
3327	Machine shops; turned product; and screw, nut, and bolt
3328	Coating, engraving, heat treating, and allied activities
3329	Other fabricated metal product
3331	Agriculture, construction, and mining machinery
3332	Industrial machinery
3333	Commercial and service industry machinery
3334	Ventilation, heating, air-conditioning, and commercial ref
3335	Metalworking machinery
3336	Engine, turbine, and power transmission equipment
3339	Other general purpose machinery

Computer and Electronic Products

NAICS	Description
3341	Computer and peripheral equipment
3342	Communications equipment
3343	Audio and video equipment
3344	Semiconductor and other electronic component
3345	Navigational, measuring, electromedical, and control instruments
3346	Manufacturing and reproducing magnetic and optical media
3351	Electric lighting equipment

Food Processing and Production

NAICS	Description
3112	Grain and oilseed milling
3113	Sugar and confectionery product
3114	Fruit and vegetable preserving and specialty foods
3115	Dairy product
3116	Animal slaughtering and processing
3117	Seafood product preparation and packaging
3118	Bakeries and tortilla
3119	Other food

Paper and Printing

NAICS	Description
3221	Pulp, paper, and paperboard mills
3222	Converted paper product
3231	Printing and related support activities

Medical Equipment and Supplies

NAICS	Description
3391	Medical equipment and supplies

Appendix B

Regional Boundary Definitions (Standard/WIB based)